

A SYSTEMATIC TREATISE HISTORICAL,  
ETIOLOGICAL AND PRACTICAL ON THE  
PRINCIPAL DISEASES OF THE INTERIOR  
VALLEY OF NORTH AMERICA V1 1850



DANIEL DRAKE

KESSINGER LEGACY REPRINTS





*Bowyer*

TO

THE PHYSICIANS

OF THE

INTERIOR VALLEY OF NORTH AMERICA,

THIS

IMPERFECT ATTEMPT

TO LAY

AN EXTENDED FOUNDATION

FOR

A HISTORY OF ITS DISEASES,

IS RESPECTFULLY INSCRIBED,

BY THEIR FELLOW LABORER,

THE AUTHOR.

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## P R E F A C E.

THE object proposed in the following work, is to give an account of the causes, symptoms, pathology, and treatment, of the principal diseases of an extensive portion of NORTH AMERICA — its INTERIOR VALLEY. In exploring it, for the purpose of collecting facts, the Author endeavored to leave behind him all opinions but the single one, that he who would observe correctly, must have no theories either to maintain or destroy.

To say that he has always been faithful to this rule of observation, would be rash ; but, he *may* say, that he has sincerely and earnestly desired, to keep himself under its sway. He may affirm, still further, that it has been his constant aim, to purify from error, the facts he was collecting ; and he trusts, therefore, that all the more important will be found substantially correct. Nevertheless, the country to which the work relates, is of such vast geographical extent, that he cannot doubt, but that every reader will detect some errors, in what relates to the topography, climate, or diseases of his own locality.

But while the object of this work is to embody facts, drawn, by personal intercourse, from numerous living physicians, or from publications made by them and their predecessors, and to combine the whole with his own observations, he has not been unmindful of the discoveries and improvements in etiology, pathology, and practice, of older and more enlightened countries ; but sought, as far as they have become known to him, to amalgamate the foreign with the indigenous, and thus present to his brethren of the Interior Valley, a book of practice, so full on all the diseases of which it treats, as to make it a useful manual for daily reference. He is obliged to admit, however, that, while seeking after knowledge among the physicians of his own country, he could give but little attention to the writings of those who live in other countries.

Long journeys of observation, repeated through a large part of several years, with elementary teaching in winter, have much abridged the time for bibliothecal research ; and, perhaps, even diminished the taste for that mode of inquiry.

Extensive as his explorations have been, large regions of country remain unvisited ; and many conclusions, at which he has



arrived, might possibly have been different, had the facts, which those regions could have furnished, been obtained by him. Yet, as his personal examinations were carried through eighteen degrees of latitude, and nearly as many of longitude, he trusts that facts which may, in some degree, stand as representatives of the whole, have been collected; and, therefore, that no general conclusion will be found radically wrong.

As announced on the title page, it is the design of this work to treat of the diseases of the Caucasian, Indian, and African Varieties of our population, in contrast and comparison with each other—the first being the standard to which the other two are brought. For this purpose, no other country presents equal advantages; since, in no other, do we find masses of three varieties of the human race, in permanent juxtaposition. There is, moreover, a fourth variety, the Mongolian, represented by the tribes of Esquimaux, whose huts of snow are scattered across the northern extremity of the Valley; who subsist on a simpler diet, and live in a lower temperature, than any other known portion of the human race; and, therefore, present, in their habits and physiology, many points of interest, to which he has given such attention as the books of voyages and travels, have enabled him to bestow.

In his traveling intercourse, with his brethren and collaborators of the Great Valley, from Florida, through to Canada, inclusive, although going among them generally, without letters of introduction, he has, with very few exceptions, been received in the kindest manner, and afforded every facility in their power; for which he cheerfully makes this public acknowledgment. To designate, by name, all who manifested a high and encouraging interest in his enterprise, would be to form a catalogue too long for introduction here; but of gentlemen residing without the United States, he is not at liberty to omit the names of Professor Joseph Morrin, of Quebec, Professor Archibald Hall, of Montreal, and Captain John Henry Lefroy, of the Royal, Magnetical, and Meteorological Observatory, Toronto, as having afforded him important assistance.

While prosecuting his researches, he visited the larger part of the military and naval posts of the Interior Valley, both American and British, bearing a letter, explanatory of his object, from Major General Scott, and received, at each, such facilities as were practicable.

He desires, also, to record the names of several young gentlemen, who have rendered him various kinds of aid, in the preparation of the work for the press. They are Doctor Charles A. Hentz, Mr. Theodore S. Dana, and Mr. Charles A. Caroland, students of medicine, and Mr. David Smith; each of whom performed the part assigned to him, in the most faithful and zealous manner. Notwithstanding this, however, it is feared that, in the statistical portions, some errors may be found, though none of great magnitude.

The hydrographical map, which forms the frontispiece of the book, seemed indispensable to its plan. The reader will perceive, that it is not designed to represent civil and political divisions; but to assist in connecting what is said on medical topography, climate, and the limits imposed by latitude and altitude, on certain diseases, into one system. It was drawn by Major D. P. Whiting, U. S. A., who also drew several of the topographical maps; the remainder and larger part were from the accurate pencil of Captain C. A. Fuller, U. S. Civil Engineer. They were all executed under the author's inspection, out of the best materials he could command; for a part of which, together with many useful suggestions, he is indebted to the veteran Topographical Engineer, Colonel Stephen H. Long, U. S. A. The engravings are on stone, by a young German artist, Mr. A. Wocher, of Cincinnati, and will, the author trusts, be found not unworthy of the typographical execution, under the supervision of Mr. Charles H. Bronson; whose abilities and taste as a practical printer, have overcome many difficulties, resulting from the introduction of more than a hundred Statistical Tables, and from the absence of the Author, at the University of Louisville, during the past winter, while the work was in the press. Finally, the Author desires to express his obligations to Messrs. Winthrop B. Smith & Co., for their willingness to turn aside from their ordinary business, and become the publishers of the largest original work which, as yet, has been written and printed in the Interior Valley; thus rendering it, in all respects, an indigenous production.

The germ of this work, was a pamphlet entitled "*Notices Concerning Cincinnati*," printed for distribution, forty years ago. The greater part of the Interior Valley of North America, was at that time a primitive wilderness. Ten years afterward, the



author formed the design of preparing a more extended work, on the diseases of the Ohio Valley; but being called to teach, he became interested in medical schools, which, with the ceaseless labors of medical practice, for the next twenty years, left no time for personal observation, beyond the immediate sphere of his own business. Meanwhile, settlements extended in all directions, with which the area of observation expanded; and the plan of the promised work, underwent a corresponding enlargement. He could look upon this long delay, without regret, if he were conscious, that his work had, thereby, been rendered proportionally more perfect; but he is obliged to confess, that the labors of a pioneer in many things, have not been auspicious, to a high degree of perfection, in any; and, that a new country, with its diversified scenes and objects, is not favorable to the concentration of attention, upon any one.

He expected to have introduced into the first volume, the article, Yellow Fever, but found it would swell the book to an inconvenient size. It will make the first part of the second volume; the materials for which have been chiefly collected, and considerable portions of it written, so that the author hopes it may be committed to the press in about a year.

On the manner in which the work (when finished) will be received by the profession, he does not attempt to form a prediction; but has entire confidence in the justice of those for whom it is especially designed. He has, also, no reason to doubt, that the periodical press of the country, will treat him with equal justice; and he desires nothing more. If a second edition should be demanded, the errors which may be pointed out, would be corrected, and new facts and observations introduced: If the work prove a failure as it respects public favor, the author will not be without his reward; for he has found enjoyment in the labor of producing it; and, having confidence in its general accuracy, knows that it must stand as a great collection of facts; a picture of the etiological condition and the diseases, of a newly settled country, in the middle of the nineteenth century; with which future, and more gifted, medical historians, will compare the causes, phenomena, and treatment of the maladies which may then prevail.

CINCINNATI, DECEMBER 20, 1849.

DAN. DRAKE, M. D.



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THE  
PRINCIPAL DISEASES  
OF THE  
INTERIOR VALLEY OF NORTH AMERICA.

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Book First.  
GENERAL ETIOLOGY.

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INTRODUCTION.

There are diseases which occur independently of all known external influences, which affect individuals of all races, and present in all cases substantially the same symptoms and lesions of structure; of which cancer, fungus haematodes, melanosis, wens, cataract, ossifications, apoplexy, and various chronic affections of the skin, may be cited as examples. There are others, depending on known and common causes to which man is exposed in all countries, climates, and states of society; such as inflammations from mechanical injuries, burns, or the ingestion of acrid poisons, which, respectively, present nearly the same characteristics, wherever or in whatever race they occur. Others, again, result from specific causes which are reproduced in the bodies of the sick, whereby they spread, with great uniformity of symptoms, to all who are exposed; such as small pox, cow pox, measles, and hooping cough. In reference to all these, and other diseases which might be mentioned, it may be said, that the observations made in one country are, in the main, equally applicable to every other. The maladies are the common scourge of our race; and the knowledge of their symptoms, lesions, and treatment, the common heritage of our profession.

On the other hand, there are diseases which scarcely ever occur but in certain climates, localities, or states of society; of which we may select for illustration, yellow fever, autumnal intermittent and remittent fever, plague, pneumonia, goitre and cretinism, gout, scurvy, and mania, most of which, moreover, in different countries, ages, and races, exhibit some variety of type, and demand some peculiarity of treatment. Here then is the foundation of local medical history and practice; a basis which does not support the whole nosology, and yet is broad enough for a large superstructure, whenever an extended region constitutes the field of inquiry.



That many physicians overrate the degree of variation from a common standard which the diseases of different countries present, I am quite convinced; but feel equally assured, that if the maladies of each country were studied and described, without a reference to those of any other, it would be found, if the state of medical science were equal in them, that the works thus produced would not be commutable, but that each would be better adapted, as a book of etiology, diagnosis, and practice, to the profession and people among which it was written, than to any other. *How much better*, would depend on the various identities and discrepancies which might exist between the countries thus compared. If their geological, hydrographical, topographical, climatic, social, and physiological conditions were nearly the same, of course their medical histories would be much alike; but if they differed widely in one or several of these conditions, a corresponding diversity would appear in the respective histories of all the diseases, which admit of modification from causes referable to those heads.

The work on which we are entering, is an attempt to present an account, etiological, symptomatical, and therapeutic, of the most important diseases of a particular portion of the earth; not of a state or political division, for it is indirectly, and to a very limited extent only, that civil divisions can originate varieties in the character of disease. Physical causes lie at the bottom of whatever differences the maladies of different portions of the earth may present; and hence the region which a medical historian selects, should have well-defined natural, and not merely conventional boundaries.

The INTERIOR VALLEY, or deeply depressed, intermontane plain of NORTH AMERICA, has been already announced, as the region to which this work relates. Great valleys have both alpine and marine borders, and the medical historian should comprehend them in his researches. Faithful to this duty, and adopting a hydrographical method, I have ascended our streams to their mountain sources, or descended them to the sea, at points exceedingly distant from each other. The vast extent of this field of inquiry would, at first view, seem to be a great disadvantage, but is, in fact, highly favorable to the development of results; as it enables us to trace a disease, in continuity, from its points of greatest prevalence, to its disappearance under new physical or moral and social conditions.

To these conditions I wish now to direct the attention of the reader. When they are subjected to a first analysis, we find them resolved into three principal groups. The first comprehends all that belong to the earth, considered in the composition and mechanical arrangement of its superficial strata, the qualities of its soil, and the amount, distribution, and quality of its waters: these are the telluric or geological influences. The second comprises all that belong to the atmosphere, in its mechanical action, sensible qualities, and adventitious impregnations: which make the climatic or meteorological influences. To the third belongs whatever appertains to society, considered in reference to national physiology, density of population, diet,

drinks, clothing, occupations, amusements, intellectual cultivation, and moral improvement: in which are embraced the social and physiological influences.

It is not necessary to decide that all the agents capable of producing diseases not found in other countries, or of modifying those which are, can be referred to these heads; but they will certainly comprehend the majority, including the most important; and whatever remain, will fall under consideration with the particular diseases which they either occasion or modify.

In describing our topography, climate, and states of society, I might have noted the relative prevalence of many diseases; but such a course would have been attended with numerous embarrassments. I selected two, therefore, which, from universal observation, are known to have a most intimate connection, in their origin or prevalence, with soil and climate; and have very generally noted the degree of their occurrence, or their absence, in each locality; thus endeavoring to maintain in the mind of the reader, the connection which, in nature, exists between topography and etiology. He must not, however, forget that this connection is not limited to those diseases, but must expect that, in the study of many others, a reference to the topographical descriptions on which we are about to enter, will frequently be made.

As an introduction to the difficult task of topographical description, over so large a surface, I have attempted to prepare, as it were, a geographical back ground, fitted (to continue the metaphor) to bring out, more distinctly, the characteristics of each locality. Thus a comprehensive outline of the physical geography and hydrology of the whole region, precedes all local description; and in the unsettled portions of the valley, comprehends all that seemed necessary to our purpose. I have also sought to give the progressive topography a geological basis, a hydrographical guidance, and a climatic order, all of which, it will be seen, was in some degree practicable. Beginning with the shores of the Gulf of Mexico, and advancing north, we pass successively over all the geological formations of the valley, from the newest to the oldest. Again, commencing at the gulf, we start on a proper hydrographical base line, and by ascending the Mississippi, are guided in the same direction as before. Again, in starting from the gulf, below the twenty-third degree of north latitude, we get a tropical base line for our climates; and in advancing to the north, reach, progressively, higher latitudes, greater elevations, and further distances from the sea. Finally, while ascending the Mississippi, if we turn from it to the east or west, we constantly attain to a higher level and a dryer surface.

If we pass out of the valley of that river into the basin of the Great Lakes and the St. Lawrence, we find similar, though less striking, relations. Thus, in descending to the south, from the summit level beyond Lake Superior to the western end of Lake Erie, we pass regularly from older to newer geological formations—from a wetter to a dryer surface—from higher to lower levels; and when we turn from the extremity of the latter lake, and advance in the direction of the St. Lawrence, we pass from newer to older geological

deposits, — from lower to higher latitudes, and from higher to lower elevations, until we reach the tides in that river. Lastly, if we pass over the dividing ridge between the waters of the southern and northern parts of the Valley, and descend the rivers which disembogue into the frozen seas of the north, we travel most of the way over primitive rocks, are constantly arriving in a higher latitude, and as constantly sinking to a lower level, until we reach the ocean.

It has been my aim to keep these various relations in view, and so to proceed with the descriptions, as to have no locality insulated, but each to follow some other in a natural sequence, and thus to arrange the whole into one topographical system.

With what degree of success this object has been accomplished, each reader will determine for himself; while all, I trust, will approve the method, and admit the inherent difficulties of its execution on so great a scale.



# PART FIRST.

## TOPOGRAPHICAL AND HYDROGRAPHICAL ETIOLOGY.

### CHAPTER I.

#### GENERAL ANALYSIS.

##### SECTION I.

###### NATURAL BOUNDARIES, AREA, AND ASPECTS.

I. NATURAL BOUNDARIES.—THE INTERIOR VALLEY OF NORTH AMERICA begins within the tropics, and terminates within the polar circle; traversing the continent from south to north, and passing through the entire northern, temperate zone. In the south it rests upon, and is deeply indented by, the Gulf of Mexico; in the north it bears a similar relation to the Polar Sea and Hudson Bay; the latter penetrating it so deeply, as to come within twenty-two degrees of latitude of the Gulf of Mexico. On the east its limits are the Appalachian Mountains, which extend from the thirty-third to the fifty-third degree of latitude, each end terminating in a low water shed. On the west, the immense chains of Rocky and Sea-side Mountains, beginning within the torrid zone and ending beyond the polar circle, exclude it from the Pacific Ocean. These mountain borders, as may be seen on the map (*Pl. I*), diverge from each other as they cross the continent, and thus the Valley regularly widens as it passes from south to north.

II. AREA.—Of the area of this great intermontane region it is not easy to speak with much precision. To the south its latitudes vary from the eighteenth to the thirtieth parallels; in the north, from the fiftieth to the seventieth. In the south, its eastern margin is found near the eighty-first meridian; its western, in the one hundred and fifth; but in the fifty-third degree of latitude, it advances east to the fifty-sixth meridian, and west to the one hundred and sixteenth; finally, in the sixty-eighth parallel, its western margin is found in the one hundred and thirty-sixth degree of longitude.

If we assume eight millions of square miles as the area of North America, the Valley cannot be estimated at less than six millions, or three-fourths of the whole continental surface. Its northern half, however, is rendered nearly uninhabitable by the state of its surface and its climate; and, therefore, the



portion which presents objects of immediate interest to the medical otologist, does not exceed three millions of square miles, of which, as yet, not more than one-third has acquired even a sparse civilized population.

III. ASPECTS.—The Rocky Mountains, which, as we have seen, constitute the western boundary of the Great Valley, are a continuation of the Cordilleras of Mexico. Their course is nearly north west, to the twenty-eighth or thirtieth parallel; then north, to the forty-fourth or forty-fifth, and then north-north west to the seventieth, where they reach the Polar Sea. Their elevation, which becomes rather greater as we advance, varies from ten to fourteen thousand feet. They are composed of many chains, closely united by offsets. Their average distance from the coast of the Pacific Ocean, to which they lie nearly parallel, is about ten degrees of longitude. Very near that coast, however, there runs another chain, of narrower base, but equal or greater altitude, especially in the far north, where some of the peaks rise to the height of fifteen or sixteen thousand feet. These mountains originate in the peninsula of California, near the tropic of cancer, and terminate about the sixtieth degree of north latitude. They are called, by Humboldt, the Californian Maritime Alps—by Fremont, the Sierra Nevada. Many of them are volcanic. The valley of the Oregon, or Columbia River, lies between this chain and the Rocky Mountains, and makes its way to the Pacific through the former, about the forty-sixth parallel.

The physician who would understand the true character of the climate of the Interior Valley, from south to north, cannot too strongly fix his attention on these lengthened and elevated mountain chains, which so effectually cut it off from the genial influences of the Pacific Ocean. In descending upon the plain, of which they constitute the western buttress, we find that they rise from five to six thousand feet above it. Beyond the fiftieth degree of north latitude, a chain of lakes approaches them, and a long river flows near their base into the Polar Sea. Below that parallel the lakes are distant; the rivers generally flow off at right angles from these mountain chains; and spurs and tracts of hill or high table land project from them, or are found insulated upon the plain, of which the most elevated and extensive are the following:

1. *The Sweetwater Mountains and Black Hills.*—Shooting out from the flanks of the Rocky Mountains, between the forty-second and forty-third parallels, the Sweetwater mountains bear to the east, from the one hundred and ninth to the one hundred and sixth meridian; when, receiving the name of Black Hills, they stretch off to the north east, and terminate about the forty-sixth parallel. Their altitude ranges from four to eight thousand feet.

2. *The Llano Estacado, or Staked Plain,* lies south of the last, in mean latitude thirty-four degrees north, and mean longitude one hundred and two degrees west. It may be regarded as an extensive tract of table land, the

general surface of which is, by estimate, two thousand feet above the streams which flow around its steep acclivities.\*

3. *The Ozark Mountains*.—They commence not far from the eastern margin of the Llano Estacado, of which they ought, perhaps, to be regarded as a rugged continuation; and, bearing north east, terminate about the thirty-eighth degree of north latitude and the ninety-first of west longitude, near the Missouri river. Their breadth is not great, and their elevation (as yet undetermined) is, perhaps, not above that of the Llano Estacado.

4. *The Coteau des prairies*, a table land rising to the height of eighteen hundred and even two thousand feet, and distributing the rivers which originate upon it, between the Mississippi and Missouri. Its head or northern extremity is in latitude forty-six degrees north.

Such are the chief protuberances on the great inclined plain, which descends from the eastern base of the Rocky Mountains, to the synclinal axis, or trough, of the Valley.

Let us pass to a similar survey of the eastern side of the Valley.

As we have already seen, the Appalachian Mountains limit the Valley plain to the east. In length and breadth they are but little more than one third as great as the Rocky Mountains,—in altitude, about one-fourth; though a few summits, both in the south and north, rise to more than one-third of the elevation of the highest points of the western chain. Their general course is north east, and mostly parallel to the western shore of the Atlantic Ocean. They are composed of interrupted, but nearly parallel, ridges; which, between the latitudes of forty-two and forty-six degrees, are cut through in two places to the level of the plain of which they are the eastern rampart, and in one place to the level of the sea. On their western side, they are flanked by an elevated belt of hills, from the latitude of forty-two to thirty-three degrees; where, in North Alabama, it turns to the west, and approaches the Mississippi in the direction of the Ozark Mountains. The plain, which stretches from the Appalachian chain to the trough of the Great Valley, is much narrower than that of the opposite side; and, although in general more rugged, presents no hills or table lands approaching in height the Ozark Mountains, the Llano Estacado, or the Black Hills. That which constitutes the greatest difference in the aspect of this, compared with the last, is its interruption above the forty-second degree of latitude, by the Great Lakes, and the formation of the St. Lawrence, which makes its way through the Appalachian chain:—for this there is no parallel on the western side.

The northern part of the interior of the continent presents much less of a valley aspect. The Rocky Mountains continue to the Polar Sea, near the seventieth degree of latitude; but the Appalachian range expires before it

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\* Commerce of the Prairies. By Josiah Gregg, now M. D.

reaches the Labrador coast of the Pacific Ocean, about the fifty-third parallel. Thus it may be said, that a great flat stretches across the northern part of the continent from the Rocky Mountains, which is reportedly indented by the sea, from the mouth of McKenzie River, near the termination of the Rocky Mountains, round to the coast of Labrador, resting on the Gulf of St. Lawrence.

It will be seen from these statements, that the eastern side of the Interior Valley is much less protected from the influences of the Atlantic Ocean, than the western is from those of the Pacific.

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## SECTION II.

### HYDROGRAPHICAL SYSTEM.

We must now take a brief preliminary view of the hydrology of the region, the boundaries, area, and aspects of which have been comprehensively sketched.

**I. SEAS.**—Penetrating deeply into the southern and northern sides of the Valley, the Gulf of Mexico and Hudson Bay (two mediterranean seas) exert a decided influence on its physical character; for they give a great extent of inland sea coast; while they, respectively, draw to themselves, from opposite directions, many large rivers which originate near each other in the central parts of the Valley, and thus establish a sort of water axis through the continent, nearly in the direction of the meridian.

**II. LAKES.**—While the south-western third part of the Valley is nearly destitute of lakes, the other parts present them in countless numbers. The smaller appear to be dispersed without any kind of order; but the larger, present a series, or system, which merits attention. Commencing with Great Bear Lake, a large sheet of water in the north-west corner of the Valley, near the Arctic Circle, west longitude one hundred and twenty-seven degrees, the lacustrine chain stretches toward the south east. To that lake at first succeeds a series of smaller ones, with intervening straits, which connect them with Great Slave Lake. After this follows, in the same range, Lake Athabasca, then the smaller lakes Wollaston and Deer, then Lake Winnipeg, of larger size, and near it the well-known Lake of the Woods, in the forty-ninth degree of north latitude and ninety-fifth west longitude, with which are connected, by the river Winnipeg, a considerable series of smaller lakes. The chain now suddenly expands into great dimensions; the first link, Lake Superior, being the largest on the continent. To this succeed Huron and Michigan, and then Erie, which approaches the flanks of the Appalachian Mountains, in the latitude of forty-one degrees north, and the longitude of eighty degrees west. With Lake Erie the axis changes from



south east to north east, and is continued in that direction, parallel to the mountains, through Lake Ontario, until it reaches the St. Lawrence; which has several lacustrine expansions, and is connected laterally with Champlain and many smaller lakes. This is, perhaps, the longest series of lakes which the world contains. The superfluous waters of those which lie farthest north, as Bear, Slave, and Athabasca, flow into the Arctic Sea. Further south, the middle portions (of which Lake Winnipeg is chief) pour their waters, through Churchill and Nelson Rivers, into Hudson Bay. The eastern, from Lake Superior to Lake Champlain, flow into the Gulf of St. Lawrence. For three fourths of its length, that is, from Great Bear Lake to Lake Michigan, the series runs almost parallel to the Rocky Mountains; diverging, however, to the north at an angle of a few degrees; while the last fourth part of the chain lies parallel with the northern Appalachian Mountains. About the ninety-seventh degree of west longitude, in Lake Winnipeg, the lacustrine axis intersects the river axis between Hudson Bay and the Gulf of Mexico. To the north east of this extended chain, on every side of Hudson Bay, the surface abounds in lakes, but they are generally small and without any known systematic distribution.

III. Rivers.—The invention of steamboats has given a new impulse to settlements on the banks of rivers. There we find the largest cities; and between them, where the banks and bottom lands are sufficiently elevated, we have the densest rural population. Thus our rivers have become objects of paramount interest to the medical etiologist; and without a full consideration of them, but little can be said on the endemic febrile diseases of the country. Reserving all details for subsequent chapters, I propose, in this preliminary and perspective view, to present a rapid, yet systematic, enumeration of the most important. For this the way has been prepared, by the general survey of our mountains, elevated plains, seas, and lakes, with some of which every considerable river, either at one or the other of its extremities, is connected. In calling them over, it will be advantageous to do it by the centers or axes in which they originate. Of these centers, some are entirely within the Valley—others, among the mountains which constitute its lateral boundaries. I shall begin with the former.

#### 1. Valley Hydrographical Axes and Centers.

A. Of these centers the most important is the region which lies west of Lake Superior, in mean latitude forty-seven degrees north, and mean longitude ninety-two degrees west. Its position, as may be seen on the map (*Pl. I.*), is near the superficial center of the continent. Its average elevation is about fifteen hundred feet above the sea, its greatest, less than two thousand, and still it sends off vast rivers, in three different directions.

a. The *Mississippi*. Rising under its own proper name, and also by its great tributary, the *St. Peter's*, or *Minisotah*, this river descends to the



south, through eighteen degrees of latitude, and after flowing three thousand miles, chiefly in the central trough of the Great Valley, pours its waters into the Gulf of Mexico, under the twenty-ninth parallel of latitude.

b. The *St. Lawrence* begins, under the name of *St. Louis*, in the same region with the Mississippi. By a rapid descent, it throws its waters into the west end of Lake Superior, to issue from the opposite extremity under the name of *St. Mary's*. Lost in Lake Huron, it reappears under the name of *St. Clair River*, which opens into the lake of the same name; whence it emerges, with a new designation, the *Detroit*, to be absorbed by Lake Erie. Out of the eastern extremity of this lake, it emerges as the *Niagara River*, to precipitate itself, by the celebrated Falls, into Lake Ontario; from which, under the appellation of *St. Lawrence*, it flows north eastwardly into the gulf which bears its name, about the forty-eighth degree of north latitude, and the sixty-fourth of west longitude, having a length of about two thousand miles.

c. *Red River, of the North*. The sources of this river lie on the same plateau as those of the two just described; whence it flows directly north, and discharges its waters into Lake Winnipeg, from which they issue under the names of *Nelson* and *Hayes' Rivers*, to be poured into Hudson Bay, in latitude fifty-seven degrees north. Its length, under different names, is about fifteen hundred miles. The bed of this river lies nearly in the same meridian with that of the Mississippi, and they flow, though in opposite directions, through the longitudinal trough of the great Interior Valley.

D. West of Lake Michigan, in the mean latitude of forty-five degrees, and between the longitudes of eighty-nine and ninety-two degrees west, there is a hydrographical axis, which, although entirely subordinate to the preceding, deserves to be noticed. Its general course is south east and north west. To the north, it throws into Lake Superior a few short and unimportant rivers,—to the east, it originates *Fox River*, which, passing through Lake Winnebago, enters Lake Michigan, by Green Bay. But the contributions of this axis to the Mississippi are much greater than to the Lakes. Thus, beginning in the north, we have the *St. Croix*, *Chippewa*, *Sappah* or *Black*, *Wisconsin*, and *Rock Rivers*, which flow to the south west, and enter the Mississippi at something like equal distances from each other,—the mouths of the first and last being more than four hundred miles apart. Of the whole, the Wisconsin is the largest, and constitutes the principal river of the state which bears its name. This axis, the mean elevation of which may be about one thousand feet above the sea, abounds in small lakes. Its northern and eastern margins approach very near to Superior and Michigan; and hence the small number and short course of the rivers of those sides, compared with the opposite.

e. The axis last described lies on the western side of Lake Michigan.

On the opposite side of that lake, through the center of the southern part of the state of Michigan, there is another axis, elevated from five to eleven hundred feet, from which the *St. Joseph's*, *Kalamazoo*, and *Grand Rivers* descend westwardly to Lake Michigan; the *Saginaw*, northerly to Lake Huron; and the *Huron*, *Raisin*, and part of the *Maumee*, eastwardly to Lake Erie.

D. In the states of Indiana and Ohio, south and south west of Lake Erie, there is a hydrographical axis, which, although, like the latter, greatly inferior to the first, deserves to be noticed. Beginning near the south-western extremity of Lake Michigan, it gradually rises on passing out of Indiana to the east, and before it has reached the western boundary of Pennsylvania, attains an elevation of eleven or twelve hundred feet. The descent from this ridge to Lake Erie is much more rapid, because shorter, than that in the opposite direction. The western part of this axis gives origin to the greatest number of rivers, although its altitude is least. Their sources are in the mean latitude of forty degrees north, and longitude of eighty-five degrees west. They consist of the following:

a. The *Kankakee*, or true head of the Illinois, which, originating in the state of Indiana, flows nearly west, at a short distance from Lake Michigan, into the state of Illinois, where it takes the name of that state, and bearing to the south west, enters the Mississippi River above the mouth of the Missouri, being the principal river of the state.

b. The *St. Joseph's*, which, originating partly in the north-east corner of Indiana, and partly in the south-west corner of the state of Michigan, flows to the north west to pour its waters into the lake of that name.

c. The *Wabash*, which, beginning in the western edge of Ohio, runs westwardly into Indiana; and, at length, turning to the south west and south, crosses the state, and enters the Ohio river, one hundred and thirty miles from its mouth. This is the great river of Indiana, and the largest tributary of the north side of the Ohio.

d. The *Maumee*. Interlocking in its origins with the Wabash, in the states of Indiana and Ohio, this river flows in an opposite direction from the last, that is to the north east, and enters the west end of Lake Erie, through Maumee Bay—being much shorter than the Wabash.

e. The *Great Miami*, whose sources mingle with those of the last two. It descends nearly south to join the Ohio River near Lawrenceburgh, at the boundary line between Ohio and Indiana, twenty miles below Cincinnati.

f. The *Sandusky*, which, originating further east, flows nearly north and expands into the bay of the same name, which opens into Lake Erie, near the city of Sandusky.

g. The *Scioto*, a counterpart of the last, which interlocks in origin with it,

and flowing nearly south by Columbus, the capital of Ohio, reaches the Ohio River at Portsmouth. This is the longest river of the state.

*h. The Cuyahoga*, which rises in the "Western Reserve," and pursues at first a western, and then a northern course to Lake Erie, at Cleveland.

*i. The Muskingum*, again the counterpart of the Cuyahoga, with which some of its eastern sources interlock, bends considerably to the west, then turns eastwardly, and finally joins the Ohio at Marietta, nearly in the longitude of Cleveland.

*j. Grand River*, the origin of which is in the same tract with that of the Cuyahoga, takes a more direct, northern course to the lake, which it enters near Painesville, thirty miles further east.

*k. Big Beaver River*, which, under the more dignified names of *Mahoning* and *Shenango*, its elementary branches, originates with the last two rivers, but flows south south east, to unite with the Ohio at the town of Beaver, thirty miles below Pittsburgh.

Besides these there are several smaller rivers: as, on the north side of the summit level, *Portage*, between Maumee and Sandusky, and *Huron*, *Vermilion* and *Black*, between the latter and Cuyahoga. On the south side, the *Little Miami*, between the Great Miami and Scioto, and *Hocking*, between the latter and Muskingum.

Thus, as we see, this is an important hydrographical axis, giving origin to most of the rivers which flow through Indiana and Ohio, while it performs the more important function of separating the waters of the Gulf of Mexico from those of the St. Lawrence, through eight degrees of longitude, or more than four hundred miles. This axis, depressed from four hundred to eight hundred feet below the hydrographical center west of Lake Superior, is, like it, a plain or table, with many ponds or small lakes, and numerous swamps.

**E.** Far to the south, but still on the eastern side of the Mississippi, we have, in the high lands of the states of Alabama and Mississippi, properly a low spur of the Appalachian chain, a fifth hydrographical axis, from which short tributaries of Tennessee River descend to the north, and several more considerable rivers flow off to the south. These are the *Yazoo* and *Big Black*, which join the Mississippi, and the *Tombeckbee* and *Tuscaloosa* that unite with the *Alabama* to form the *Mobile*, which disembogues into the Gulf of Mexico.

Such are the interior hydrographical centers on the eastern side of the Mississippi. We must now pass to the western, and begin in the south.

**F.** In the northern part of the state of Texas, far in the south west of the Valley, there is a hilly axis, which throws out the *Sabine*, *Trinity*, *Brazos*, *Colorado*, and *Nueces*, which flow into the Gulf of Mexico.



G. Ascending northwardly we come, between the thirty-sixth and thirty-eighth degrees of latitude, to another center—the Ozark mountains. Besides certain branches of the *Arkansas River*, and of the *Great Osage*—a tributary of the *Missouri*—the *Gasconade*, another affluent of that river, and the *Maramac*, *St. Francis*, *White River*, and *Washita*, tributaries of the *Mississippi*, have their origin, in whole or in part, in the Ozarks.

H. Advancing to the north west we come to the Black Hills, in the great bend of the *Missouri River*, which send all their streams into that river on the east, or into its large tributary, the *Yellow Stone*, on the west.

We have now passed over all the important hydrographical axes and centers of the southern part of the Great Valley, and a few paragraphs will suffice for those of the north, lying beyond the great Lakes and the sources of the *Mississippi*.

I. The water table between Hudson Bay and the Lakes and *St. Lawrence*, sends forth several rivers to the former, or into *Lake Winnipeg*, of which the *Abbitibbe* and *Rupert* may be mentioned. It also gives origin to the *Ottawa*, *St. Maurice*, *St. Anna*, and *Saguenay*, important tributaries of the *St. Lawrence*, which of course flow in an opposite direction.

J. Finally, far to the north west, in the sterile regions east of *Great Bear Lake*, there is a center whence the *Yellow Knife River* flows into an arm of *Great Slave Lake*, and the *Copper Mine* and *Thlew-ee-chok*, or *Back's River*, into the *Polar Sea*.

## 2. Mountain Border Axes and Centers.

By a natural transition, we ascend from this part of the Valley to the most distant of the mountain axes in the north west.

A. The Northern Rocky Mountain Axis. In the magnitude of the rivers which it originates, this is the greatest axis on the continent. Its mean latitude is fifty-one or fifty-two degrees north west, its average longitude one hundred and fifteen. Its general elevation is ten or twelve thousand feet; but it embraces *Mount Brown* and *Mount Hooker*, which rise much higher. Its rivers may be divided into those which flow into and through the Valley, and those which make their way, in the opposite direction, to the *Pacific Ocean*. We begin with the former.

a. *Mackenzie River*, of which the most northern branch—latitude fifty-nine degrees—is the *Liards* or *Turn Again*; then the *Unjigah* or *Peace River*; lastly, the *Athabasca*. It flows through most of its course near the base of the mountains, and enters the *Polar Sea*, having its *embouchure* in the north-west corner of the Valley, at a higher latitude than any other river of the continent.

b. The north and south branches of the *Saskatchewan*, which flow eastwardly to Hudson Bay.

c. The *Missouri*, which, by its northern branch, the *Maria*, has a connection with this axis.

d. *Frazer River*, which flows southerly, and discharges its waters into the Pacific Ocean through Vancouver Sound, in north latitude forty-nine degrees.

e. The *North Fork of Oregon or Columbia River*, which, after uniting with the *South Fork*, reaches the same ocean, a little above the forty-sixth parallel, near the one hundred and twenty-fourth meridian.

B. The Southern Rocky Mountain Axis. The mean latitude and longitude of this axis may be taken at forty-one degrees north, and one hundred and seven degrees west. Its average elevation is eleven thousand feet. On the east or valley side, it sends down:

a. The southern rivulets of *Big Horn*, an important branch of the *Yellow Stone*, which, flowing north east through six degrees of latitude, unites with the *Missouri* under the forty-ninth parallel.

b. The *Nebraska or Platte*, which, flowing nearly east, traverses the great inclined plain of the Rocky Mountains, and empties into the *Missouri River*, below the *Yellow Stone*, in the forty-first degree of latitude.

c. The *Kansas*, which flows nearly east, to unite with the *Missouri* below the *Platte*, precisely at the western boundary of the state of *Missouri*.

d. The *Arkansas*, which traverses the same plain, at first to the east, and then to the south east, until it joins the *Mississippi*, near the thirty-fourth degree of latitude, thirteen hundred miles below the *Platte*, and more than two thousand below the *Yellow Stone*.

e. *Red River*, which has less connection with the axis than the last, and after flowing eastwardly for several hundred miles, turns to the south-south east, to discharge its waters into the *Mississippi*, in north latitude thirty-one degrees, being the last tributary of that great river.

f. The *Rio del Norte*, which descends to the south, then turns to the south east, and discharges its waters into the Gulf of Mexico, in latitude twenty-five degrees.

As the *Missouri*, after receiving the *Yellow Stone*, *Platte*, and *Kansas*, unites with the *Mississippi*, it follows that all the eastern rivers originated by this hydrographical axis, except the *Rio del Norte*, discharge their waters into the gulf through that great river.

On the western side of the Rocky Mountains, the center we are now considering, originates:

*g.* The southern fork of the Columbia, known under the name of *Lewis River*, which flows nearly north west to join the Northern Branch, or *Clarke River*, at Wallah Wallah, and then proceeds to the Pacific Ocean.

*h.* The *Rio Colorado*, which, pursuing a south-westerly course, enters the northern extremity of the Gulf of California, about the thirty-second degree of north latitude.

Let us now turn to the eastern or Appalachian mountain chain, beginning in the north. The rivers which it originates are smaller, and the hydrographical centers less obvious, but still recognizable.

**A.** The elevated White and Green Mountain axis, sends down to the north the *Chaudiere*, *Nicollet*, *Yamaska*, *St. Francis*, and many smaller rivers to the St. Lawrence; to the west, they pour several streams into Lake Champlain, whence they make their way through the *Richelieu* to the same great river; to the south, they give origin to the *St. John's*, *Penobscot*, *Kennebec*, and *Connecticut*, which flow into the Atlantic Ocean.

**B.** The Adirondack center, lying between Lake Ontario and Lake Champlain, in mean latitude and longitude, forty-four and seventy-four degrees, has an average elevation at four thousand five hundred feet, and originates a number of rivers, which radiate in all directions.

*a.* To the east, it sends down the *Saranac*, the *Au Sable*, and some smaller streams which empty into Lake Champlain.

*b.* To the north, the *Salmon*, *St. Regis*, *Racket*, *La Grasse*, and *Oswegatchie*, tributaries of the St. Lawrence.

*c.* To the west, *Black River*, of Lake Ontario.

*d.* To the south, *West Canada River*, in which are the celebrated Trenton Falls, by which it descends to the *Mohawk*. Lastly,

*e.* The *Hudson*, which flowing also to the south, enters the Atlantic Ocean at New York.

The area of this center is small, and the rivers which it originates, though numerous and abounding in water, are short.

**C.** Further west and south, in the mean latitude of forty-two degrees and longitude of seventy-eight degrees, lying in the states of New York and Pennsylvania, we have another Appalachian center, the average height of which is about eighteen hundred feet. The rivers which flow from it are as follows:

*a.* To the north, the *Genessee*, or principal river of Western New York, which discharges its waters into the middle of the south side of Lake Ontario, after traversing less than a degree and a half of latitude.



b. The *Oswego*, which likewise enters Lake Ontario, and discharges the water of many long, narrow lakes, which are fed by streams which originate in this center.

c. To the east we have many of the western branches of the *Susquehanna*, which, pursuing nearly a south-easterly course, enters the head of Chesapeake Bay.

d. From the south-western declivity of this center, all the head waters of the *Alleghany* descend to form that river, which, pursuing a southerly course to Pittsburgh, joins the *Monongahela*; when the united stream takes the name of *Ohio*, and flows in a west-south-west course to the Mississippi.

D. Between the thirty-eighth and thirty-ninth degrees of north latitude, and seventy-ninth and eightieth of west longitude, in the state of Virginia, we have a third hydrographical axis, in which are found the celebrated mineral springs of that state. Its average levels may be given at two thousand feet. To the east it throws off—

a. The *Potomac*, which, after bending to the north, turns south easterly, and enters Chesapeake Bay.

b. *James River*, lying south of the last, running more directly east, and entering the same bay near its junction with the Atlantic Ocean.

c. To the north, this center sends out the *Monongahela*, which flows in that direction, to unite, at Pittsburgh, with its larger and longer fellow, the *Alleghany*, in forming the *Ohio* river.

d. From the same center, *Greenbrier River* passes off to the south west, and descends, by a comparatively short course, into the *Kanawha River*, and thence into the *Ohio*.

E. The last hydrographical axis in this chain of mountains is found chiefly in the state of North Carolina; but it comprehends, also, the south-west angle of Virginia, the northern parts of South Carolina and Georgia, and the eastern margin of Tennessee. Its mean latitude is thirty-six degrees—its mean longitude, eighty-two degrees. Its mean elevation is greater than either of the last two, being not less than three thousand feet, with some peaks much higher.

From the eastern and southern margin, it throws into the Atlantic Ocean—

a. The *Roanoke*, or at least one of its largest branches, which enters Albemarle Sound.

b. *Cape Fear River*, wholly within the state of North Carolina, which reaches the Atlantic Ocean by a south-east course.

c. The *Yadkin*, which, on entering South Carolina, takes on the name of

*Pedee*, and continuing in a direction east of south, discharges its waters into the Atlantic.

d. The *Catawba*, or *Waterce*, the *Broad River*, and the *Saluda River*, which con verge into a common trough that bears the name of *Santee*, and by a south-easterly course, arrives at the Atlantic.

e. The *Savannah*, which, for most of its course serves, as the dividing line between South Carolina and Georgia. It holds a direct, and nearly south-east direction to the Atlantic Ocean.

Let us now turn to the interior, and enumerate the most important rivers which flow over it, from this axis.

f. The *Kanawha River*. To the north this summit level sends off the *Kanawha*, which for some distance bears the name of *New River*. Its course is first north east, and then north; so that it actually passes through the edge of the hydrographical center last described; after which it bends to the north west, to unite with the *Ohio River*, at Point Pleasant, two hundred and seventy four miles below Pittsburgh, about the thirty-ninth degree of latitude, and nearly in the longitude of its most distant sources. Its length is greater than that of either of the rivers just enumerated.

g. The *Big Sandy River*, the head springs of which are in the northern brow of this center, whence they descend to the north, and uniting, flow into the *Ohio*, about sixty miles below the *Kanawha*.

h. The *Kentucky River*, which flows in a north-west course from the same margin, and joins the *Ohio*, at Carrollton, between Cincinnati and Louisville.

i. The *Cumberland River*, whose sources, like those of the last two, are found in the north-west flanks of the same mountain center. Its course is at first west, through the south-east corner of Kentucky, then south west into Tennessee, then west, and finally north north west, across the state from which it had departed, to the *Ohio River*, at Smithland, fifty-six miles from the junction of that river with the Mississippi.

j. The *Tennessee River*. The origin of this river is largely from the hydrographical center we are now studying. The main trunk, which bears the name just mentioned, is composed of the *Clinch*, *Holston*, *French Broad*, and *Tennessee* proper. The *Holston* connects itself most intimately with the central portions of the summit level, where it interlocks with the sources of the *Kanawha*. The *Tennessee*, constituted by the union of these mountain streams, descends to the south west, through the eastern end of the state which bears its name; then passing within eight of the north-west corner of Georgia, and dipping into North Alabama, as low as the latitude of thirty-four degrees thirty minutes, it wheels to the north, and traversing the states of Tennessee and Kentucky, in the meridian of eighty-eight degrees west, joins the *Ohio*, of which it is the largest tributary, at Paducah, forty-five miles from the Mississippi. This junction is six hundred and sixty miles

below that of the Kenawha, while the head rivulets of the two rivers are in the same locality.

*k. Chattahoochee River.* Its sources, which interlock with those of the Tennessee, are found chiefly in the state of Georgia, and the south-west corner of North Carolina. At first its course is south west, but at length changing to the south, and becoming a boundary line between Georgia and Alabama, it traverses middle Florida, and reaches the Gulf of Mexico, through Appalachicola Bay, below the thirtieth degree of latitude, and a little west of the eighty-fifth degree of west longitude.

*l. The Alabama River.* About the latitude of thirty-five degrees, and longitude of eighty-four degrees, that is, from the western outliers of this hydrographical axis, the Alabama, under the name of *Coosawattee*, afterward *Coosa*, has its origin in the northern part of Georgia. Entering the state of Alabama, near the north-east corner, it holds a south-south-west course to the Gulf of Mexico, near the south-east corner of the state; having been joined by the *Tallapoosa*, whose sources are a little south of its own.

Such are the principal rivers which arise, in whole or in part, in this great hydrographical axis, which constitutes the southern extremity of the Appalachian chain. Subordinate to these, however, there are several others which originate in the outliers and hill lands that flank the mountain platform. On the Atlantic side, they are, the *Cape Fear*, *Pedee*, and *Altamaha*, of the Carolinas and Georgia. On the continental or valley side, the *Guyandotte*, in Virginia, and *Licking* and *Green Rivers*, in Kentucky, which discharge their waters into the Ohio.

The radiation from this axis extends round three fourths of a circle, that is, from the east, by the south and west, to the north; and the states traversed by the rivers which thence flow off are, Virginia, in its south-western portions, the Carolinas and Georgia, a small part of Florida, the larger portion of Alabama, and nearly the whole of Tennessee and Kentucky.

To the seventeen preceding valley and mountain hydrographical axes, nearly all the rivers of the continent may be referred. In their origins, however, they are not actually limited to the centers and axes with which they have their chief connection. Thus, the portions of mountain which lie between the five Appalachian centers just described, act as water sheds between the Atlantic plain and the Interior Valley; the whole range of the Rocky Mountains throws down streams into the heart of the continent, and also into the Pacific Ocean, yet they chiefly flow from the two portions of that chain which have been indicated. Still further, within the Valley, a water shed everywhere divides the streams of the north from those of the south; and yet, the centers and axes west of Lakes Superior and Michigan, and south of Lake Erie, send out nearly all the rivers which have their origin *within* the Valley.



## SECTION III.

## ALTITUDES AND CONFIGURATION.

It has been already intimated that the interior of the continent is traversed by a deep, winding, longitudinal depression, constituting a synclinal axis, which extends from the Gulf of Mexico to Hudson Bay. The Mississippi is found in this trough, through two thousand one hundred and ninety-two miles, and nearly sixteen degrees of latitude; that is, from the gulf, in latitude twenty-nine degrees north, to the mouth of St. Peter's River, in north latitude forty-four degrees fifty-two minutes. Here the axis makes a *detour* to the west, and incloses the latter river for four hundred and thirteen miles, to the upper end of Big Stone Lake,\* into which the St. Peter's, having its origin in the adjacent *Coteau des prairies*, on the west, discharges its waters. Within three miles of this point, to the north, is the southern end of Lake Traverso. The ground between them is low, and when the St. Peter's is swollen, it sometimes sends a portion of its waters into this lake, so that canoes have passed from one to the other.† From the other extremity of Lake Traverso, Swan, or Sioux Creek flows to the north, and unites with Red River, which, having descended from the highlands to the east, now occupies the synclinal axis to Lake Winnipeg, in north latitude fifty degrees twenty minutes. From the north end of the latter lake, in latitude fifty-three degrees forty-two minutes, to Hudson Bay, in latitude fifty-seven degrees, the axis embraces Nelson River. Having traced it to the sea, let us return to the summit level or culminating line, between Big Stone and Traverso Lakes. Its distance from the Gulf of Mexico, following the sinuosities of the trough, is two thousand six hundred miles; its longitude ninety-six degrees thirty-four minutes west; its latitude forty-five degrees thirty-five minutes, or sixteen degrees thirty minutes from that of the *embouchure* of the Mississippi. Its altitude, Colonel Long assures me, cannot exceed nine hundred and seventy-five feet, if Mr. Nicollot be correct in assigning nine hundred and sixty-six feet as the elevation of Big Stone Lake. This gives a rise from the Gulf of Mexico of nearly twelve inches for every minute of latitude; and of four inches and a half for every mile, following the course of the river.

As the distance from this line of culmination to Hudson Bay is but twelve degrees thirty minutes of latitude, and the long level of Lake Winnipeg intervenes, it follows that the descent of the trough to the north is under a different law from that to the south. To Lake Winnipeg, now estimated by Colonel Long at the elevation of seven hundred and fifty feet, the fall is gradual and moderate; from that lake to Hudson Bay, precipitous.

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\* Nicollot. Hydrographical basin of the Upper Mississippi, 1841.

† Narrative of an Expedition to the source of the St. Peter's River, under the command of Stephen H. Long, Major U. S. T. F. Compiled by N. H. Keating, 1823.

A projection or profile of this water curve may be seen in *Pl. II, Fig. 1*. Its northern extremity is three degrees thirty minutes west of its southern, the longitude of the latter being eighty-nine degrees six minutes west, that of the former ninety-two degrees thirty-six minutes; but at the summit level, as we have just seen, it is ninety-six degrees thirty-four minutes, and at the efflux of Nelson River from Lake Winnipeg, ninety-eight degrees, or nine degrees west of the mouth of the Mississippi.

A wide and deep current from the north, must have excavated this trough across the continent, and Lake Traverse and Big Stone Lake, are but hollows or chasms, left filled with water when that river ceased to flow. They are long, narrow, serpentine, and lie in the course of the obsolete river. They resemble the pools of a wet-weather stream, during a drought, or, more exactly, the crescent lakes of the lower Mississippi, which, as we shall hereafter see, were once portions of its ancient channel.

The width of these lakes is from one to two miles, and the immediate valley in which they lie but two or three times as much; then comes a rise of fifty or one hundred feet, with a gradual ascent beyond, to the elevation of one thousand eight hundred or two thousand feet, on the *Coteau des prairies* to the west, and another nearly as high, to the east, on which the Mississippi originates.

Such is the great continental aqueduct, which, from the junction of Red River with the Mississippi, in the state of Louisiana, under the thirty-first parallel, to the Saskatchewan, which unites with Lake Winnipeg and Nelson River about the fifty-fourth degree, receives and transmits, to the seas of the south and the north, all the superfluous waters which fall to the west of the trough, as far as the crests of the Rocky Mountains.

As this long synclinal axis runs nearly parallel to the mountain ranges, the inclined plain which lies between them is an irregular parallelogram. Its general aspect is to the east, but as it advances from the mountains, one portion inclines to the south, and another to the north. The line of this culmination leaves the Rocky Mountains about the forty-eighth or forty-ninth degree of north latitude; and advancing a little south of east, reaches Lake Superior, which is, as it were, set into its eastern extremity. On its way it is cut through by the trough or synclinal axis which has been described.

Let us turn to the region east of that axis. Measured from south to north, its length is nearly as great as that of the western plain, but its breadth far less, and very unequal in different latitudes. Below the latitude of thirty-four degrees it is narrow; it then suddenly spreads out to its greatest width, having for its eastern limits the spines of the Appalachian Mountains, from North Carolina to Pennsylvania; when, about the latitude of forty-one degrees north, its breadth is reduced nearly two thirds, and so continues to Hudson Bay. Through this plain there is also a culminating ridge, which extends from the mountains toward the central water axis.







From the southern side of this elevation, the waters ultimately reach the Gulf of Mexico, through the Mississippi; from the northern they fall into the Lakes and the St. Lawrence, and reach the Atlantic Ocean to the north east.

Here, then, is a new and distinct hydrological system — another synclinal axis, somewhat at right angles to that which has been delineated, and confined to the middle portion of the eastern plain. It begins with Lake Superior, and ends with the Gulf of St. Lawrence. In times past it had extensive water communications with the last, by several rivers, but especially the Illinois, which originates around the southern extremity of Lake Michigan, and flows to the Mississippi through a depression in the intervening barrier; which is so deep, that in times of flood, canoes have passed from one trough or synclinal axis into the other.

It results, from what has been said on the deep cuts which traverse the Interior Valley, that two voyagers might start from the Gulf of Mexico, in the latitude of twenty-nine degrees north; and ascending the Mississippi to the mouth of the Illinois river, one of them might take the course of that stream; pass into the Lakes, over an elevation of six hundred feet; descend the St. Lawrence; and make his exit into the Atlantic Ocean, upon the fishing banks of Newfoundland; twenty degrees north and thirty degrees east of his place of departure. The other, continuing up the Mississippi and over the Lake Traverse summit level, at the height of nine hundred and seventy five feet, would descend into Hudson Bay; whence he might pass into the polar sea, amid perpetual ices; after having traversed more than forty degrees of latitude.

Let us develop still further the relative altitudes and configuration of the intermontane plain, through which such voyages might be performed, by supposing curves, like those in *Pl. II, Fig. 1*, to be described over its whole surface; and, *first*, of those which might pass from south to north. If one were drawn for every degree of longitude, from the synclinal axis to the Rocky Mountains, it would be found (if its extremities rested on the sea) that the convexity of each would be greater than that of the preceding; and that the whole would traverse the rivers nearly at right angles. It would also be seen that, in the north, the lines thus projected would approach the level sea much more slowly than to the south; indicating that the broad region west and north west of Hudson Bay, inclines to the sea in a very gradual manner, and thus explaining its lacustrine character. If similar longitudinal curves were projected on the eastern side of the axis, the first two or three would rise with great regularity, pass over the high plateau, where we find the sources of the Mississippi, of Red River, and the St. Louis, and then sink to the level of Hudson Bay, by a rapid descent, intersecting many rivers in their progress. The next would display a different character. Ascending from the gulf, they would, after a regular rise to the latitude of thirty-four degrees north, mount over the spur of the Appalachian Mountains, which has

been mentioned as stretching across the northern part of Alabama and Mississippi; descend, and traversing the Tennessee, Cumberland, and Ohio basins, at a hill summit elevation everywhere nearly the same, ascend the low summit level between the Ohio River and the Lakes; sink to the level of the latter, and beyond them rise to a higher level than attained before, from which to decline, at an equable ratio, into Hudson Bay.

Such a line, if projected on paper, would not be convex like those over the great plain west of the Mississippi, but serpentine, having three elevations and two depressions. Further east, we encounter the flanks and outliers of the Appalachian Mountains, which prevent one of these depressions; but the other, depending on the lakes, continues, and even deepens as the lake surfaces sink lower in the east.

In the second place, let us give attention to the surface curves of elevation and depression, which might be drawn transversely to the Valley, from east to west, and consequently at right angles to those which have been described. Everywhere west of the great synclinal axis, such curves would rise from it more rapidly, extend further, and ultimately attain to a greater and more uniform elevation, than those which might be extended from that axis to the east. Thus, from within the tropics to the latitude of thirty degrees, or the northern coast of the Gulf of Mexico, curves drawn from west to east, would descend with great rapidity from the summits of the Cordilleras of Mexico, at the altitude of ten or twelve thousand feet; cross the gulf, and rising, terminate on the mountains of Cuba, and on the still lower water table, which traverses the long peninsula of Florida, from south to north. From the northern coast of the gulf to the shores of Lake Michigan, such lines would descend rapidly from the lofty spines and peaks of the Rocky Mountains; then curve more gently over the broad, inclined plain which stretches from the base of those mountains to the synclinal axis; dip into that axis, reascend, and traversing the narrower and less elevated plain to the east, rest on the summits of the Appalachian range, at an altitude a third or fourth as high as that of their western extremities.

A specimen curve of this class is given in *Pl. II, Fig. 2*. For want of the requisite data it could not be projected under one parallel, but its extremities differ only a few degrees. The scale on which it is executed did not, moreover, admit of its being started from the summits of the Rocky Mountains, but they are indicated on the plate. Beginning at the South, or Fremont's Pass, it takes the course of the Sweetwater and Platte Rivers; passes thence to the Kansas; descends that river to its mouth, and then continues down the Missouri to the Mississippi;—having traversed the great western plain, from the height of thirteen thousand five hundred and seventy feet (if we suppose it projected from Fremont's Peak) to that of three hundred and eighty-eight feet, the elevation, according to Nicollot, of the great synclinal axis, at the mouth of the Missouri River. It now reascends,



and, still bearing a little south of east, passes over Illinois and Indiana; crosses the Ohio River at the Falls; traverses the state of Kentucky, and may be supposed to terminate on the Balsam Mountain of Virginia; which Professor Rogers informs me has an altitude of five thousand two hundred feet.\*

This profile, while it demonstrates the true valley character of the interior of the continent, will serve, especially, to illustrate the portion which lies between the thirty-third or thirty-fourth and the forty-first parallels of latitude. In passing further north, the form of the curve undergoes a change.

A line projected in the forty-second degree would descend, like the last, from the summits of the Rocky Mountains; cross the synclinal axis, where the surface of the Mississippi is six hundred feet above the sea; then curve over hills two hundred feet higher; then sink to the level of Lake Michigan, five hundred and seventy-eight; traverse that lake; rise to one thousand over the water shed between it and Lake Erie; cross the south-western portion of that lake; and ascend the mountains of New York and Pennsylvania, to an elevation of two thousand feet. Another, in the latitude of forty-three degrees, would describe a curve of the same kind, to the synclinal axis, at Prairie du Chien, where the surface of the Mississippi is six hundred and forty-two feet above the sea; then ascend the water table between that river and Lake Michigan, three hundred feet higher; traverse the lake and the water shed to its east as before; sink to the level of the straits which connect Huron with Erie, five hundred and seventy feet; then rise to the elevation of from eight hundred to one thousand feet, in traversing Canada, north of Lake Erie; then sink to five hundred feet at the Falls of Niagara; pass on through Western New York, near the same level; descend the valley of the Mohawk, enter that of the Hudson, and, by a little deflection to the south, terminate on the Atlantic Ocean, at the city of New York. A curve in the latitude of forty-four degrees, intersecting the synclinal axis at an elevation of six hundred and eighty-four feet, would have all the inflexions of the last; sink to the level of two hundred and thirty-two feet, at the efflux of the St. Lawrence from Lake Ontario; then reascend, and terminate on the summits of the Adirondack Mountains, in northern New York, at the altitude of four thousand feet. The curve of the next parallel, forty-five degrees, descending from the mountains like the rest, would intersect the synclinal axis where the surface of the St. Peter's River, occupying it, is nine hundred and forty-six feet, or thirty feet below its greatest elevation; ascend the high lands between that river and the Mississippi; pass the Falls of St. Anthony, eleva-

\* The data for this curve are derived from Fremont, Nicollet, the civil engineers of Illinois, Indiana, and Kentucky, and the geologists of Virginia. Many of the altitudes west of the Mississippi are those of rivers, at low water, while those to the east are the summit levels of the low hills. My draughtsman, Captain Fuller, has endeavored to show the different kinds of surface — prairie, woodland, and river.

ted eight hundred and fifty-six feet; rise to one thousand before descending upon Lakes Michigan and Huron, with their intervening water shed as before; then traverse Canada West; sink to the level of the St. Lawrence a short distance above Montreal; and finally, by a rapid ascent, rest on the Green and White Mountains of New England, at the altitude of four or five thousand feet.

The curve of forty-six degrees would pass over the head of the *Coteau des prairies*, which is two thousand feet in high; then intersect Red River in the synclinal axis a little north of its greatest elevation, at the altitude of about nine hundred and sixty feet; then rise upon the sloping plain, from twelve to fourteen hundred feet high, on which the Mississippi descends; then range over the water shed between Lake Michigan and Lake Superior, at a still higher altitude; then sink to the level and pass through the northern margin of Lake Huron, at five hundred and seventy-eight feet; to rise again as it traverses Canada, to the general height of eight or nine hundred feet; then descend and cross the St. Lawrence a short distance above tide water; after which, suddenly rising, to rest upon that portion of the Appalachian chain which is found in Lower Canada and the state of Maine, at the height of three thousand feet. The curves, representing the forty-seventh and forty-eighth parallels of latitude, cut the synclinal axis where Red River, which still occupies it, has an elevation of more than eight hundred feet; whence they mount upon the plateau, about fourteen hundred feet high, on which, and between which parallels, the Mississippi, Red River, and the St. Louis have their sources. From this elevation they descend to Lake Superior, six hundred and twenty feet, which they traverse from end to end; then reascend to the general elevation of one thousand feet, as they traverse Canada; then descend to tide water, in crossing the St. Lawrence below Quebec; whence they rise upon the last portion of the Appalachian Mountains, south of that river, and cease at the elevation of about three thousand feet. The parallel of forty-nine degrees, gives a curve which descends on the water shed between the Missouri and the Saskatchewan of Hudson Bay; dips to the level of about eight hundred feet, in crossing Red River in the synclinal axis; rises, touches the Lake of the Woods, passes along the water shed between Hudson Bay to the north, and Lake Superior and the St. Lawrence to the south, at the altitude of fifteen or eighteen hundred feet; then suddenly sinks into the estuary of the St. Lawrence, and passes out to the Atlantic Ocean. This curve is distinguished from the preceding, by the high and uniform level which it maintains; and by representing, through nearly its whole length, the water shed which separates the streams which flow into Hudson Bay, from those which cast their waters into the Gulf of Mexico, the Lakes, and the St. Lawrence.

The curves of the next two parallels, in descending, cross the synclinal axis in Lake Winnipeg, at the level of seven hundred and fifty feet; then reascend, but not to as high a level as the last; pass near to the south-eastern

projection of Hudson Bay; rise over the expiring extremities of the Appalachian chain beyond the St. Lawrence, and then suddenly sink to the level of the ocean.

The high lands, or mountains, near the eastern margin of the continent, are now at an end, and the valley plain opens out upon the Atlantic Ocean, or Davis' Strait. We have now arrived at Hudson Bay, which penetrates into the very heart of the continent. On the west, however, the lofty Rocky Mountain border, continues unbroken and unrelaxed in altitude. The curves of every parallel of latitude, descend as before from their summits, and reach their lowest level in Hudson Bay; beyond which, through eight or ten degrees of latitude, they rise to the (uncertain) elevation of nine hundred or one thousand feet, and terminate with the coast of Labrador. From the sixtieth to the seventieth degree, the curves still descend from the high level, but terminate in Hudson Bay, or the straits which connect it with the Polar Sea.

Thus, we find that the curves in the extreme north, are almost identical with those of the extreme south; and that the configuration of the Valley, after we reach Hudson Bay, is nearly the same with that around the Gulf of Mexico.

The mechanism of the Interior Valley may be still further illustrated, by supposing certain horizontal planes or lines, to be carried in various directions over its surface. Thus a horizontal plane, at the altitude of twelve thousand feet, applied to the whole range of Rocky Mountains, from the latitude of eighteen degrees to sixty-eight degrees, north, would cut through many peaks, and pass over many others; the excesses and defects of elevation, perhaps, nearly compensating each other; and a plane at the elevation of three thousand five hundred or four thousand feet, applied to the Appalachian range, would give nearly the same result; and if a plane at this elevation were carried from the entire length of the Appalachian Mountains, westerly, it would not reach the Rocky Mountains, but cut the great prairies far on this side.

The plane at the elevation of a thousand feet, or of the culminating line or the synclinal axis, at Lake Traverso, nine hundred and seventy-five feet, would pass a little above, or rest upon, or cut through, the summits of those portions of the Valley which are comprehended in the following states: Iowa, Missouri, except the Ozark Hills, north-eastern Mississippi, north Alabama, middle Tennessee, western and middle Kentucky, Ohio, Indiana, Illinois, Wisconsin, Michigan, and Canada West. The same plane, carried to the north, would apply with equal accuracy to a far greater area. Finally, a series of horizontal planes, rising from two hundred and thirty-two to seven hundred and fifty feet, and then sinking through the same scale, would rest on the surfaces of all the great lakes, from Ontario up to Winnipeg; and thence down through Deer, Athabasca, and Slave, to Great Bear Lake; the whole lying in one axis (broken only by the high lands between Superior and Winnipeg), and ranging with the longest diagonal of the Valley, from



south east to north west. One extremity of this range is in latitude forty-three degrees north, and longitude sixty-seven degrees west; the other in latitude sixty-seven degrees north, and longitude one hundred and twenty-four degrees west.

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## SECTION IV.

### GEOLOGICAL OUTLINE.

Having shown the peculiar geographical and hydrographical system of the Great Valley, it will be proper to give a comprehensive introductory notice of its mineral geology.

I. The soil or loose covering of the surface of a country consists naturally of the *debris* of the subjacent rocks, gradually accumulating upon them, and varying in depth and qualities according to their mineral constitution. As some rocks undergo disintegration much more rapidly than others, it follows, that they have covered themselves with a deeper bed of their ruins. Thus the shales, marls, and soft slates, with many sand and limestones, decay more rapidly than granite, or syonite, and other primitive rocks, and therefore have a thinner soil.

When the rains wash this pulverulent *debris* from the hills to the valleys, it is borne along by the streams, and gradually deposited in beds, which are raised higher by each successive inundation of the banks. These are the alluvial grounds or bottom lands. In composition they are by no means so simple as the soils which remain *in situ*, for the wreck of various strata are mingled, and a variety of organic matters, transported by the waters, become enveloped in them. By this transportation, it may happen, that the banks of the lower portions of a river, or the shores of a lake in which it disembogues, may be composed of materials widely different from the rocks on which they rest; of which our Great Valley presents many striking examples. All its rivers, when swollen by rains, and some even in their lowest depression, transport a variety of materials; and often deposit them at great distances from their original beds; thus creating a most extensive and complicated system of alluvial grounds; some of which become dry after the freshets have subsided, while others remain permanently covered with water, in the form of shallow ponds, marshes, or mere swales. It is not practicable, to estimate the area of these grounds; but they are so continuous, that every part of the Valley, from mountain to mountain, and from sea to sea, might be traveled over, without leaving them except to cross the streams by which they have been deposited.

II. What has been said, affords but a limited conception of the surface of the Interior Valley. Along many of its rivers, and even mill streams, there are, in the rear of the alluvial bottoms, older and higher deposits of transported materials; which, it may be seen at a single glance, were made by

ivers incomparably deeper and broader than those which now flow in the same valleys. These are commonly called second bottoms, and might sometimes receive a still higher numerical designation; for, now and then, we see a third terrace. From the great length of time since they were deposited, the organic matters which they enveloped, are dissolved; and, as they are no longer subject to river inundations, their surfaces are seldom marshy. In the aggregate, these ancient deposits are of less area than the recent alluvions, for they are found along a part of our rivers only.

III. Nearly related to, if not identical with, these old terraces, are the deposits on the general surface of the country; overspreading the hills and valleys alike, and varying in depth from a few feet to a hundred or more. They are found from the level of the sea in the south, up to the height of at least fifteen hundred feet; both on the mountain slopes and elevated portions of the Valley plain. The materials which compose them, are water worn, and their arrangement, not less than their miscellaneous character, shows that they have been transported from the north. Nearly coëxtensive with these deposits, we find immense boulders, or blocks of granite and other primitive rocks, at vast distances from their parent strata, indicating not only great depth of water, but buoys of moving ice in which they must have been imbedded.\* Modern geology does not require a further development of this subject, and it only remains to add, that these deposits have received the different names of diluvion, drift, and post tertiary; and that they give to the regions in which they abound, a surface which bears no relation, in its mineral character, to the rocks which are buried up beneath. They have, also, by filling up the inequalities of a rocky surface, produced one of greater levelness, and thereby favored the production of ponds and marshes.

IV. We must now penetrate the loose, upper coverings, and briefly indicate the nature of the strata below. In doing this, if we begin, as in the study of our physical geography, at the Gulf of Mexico, and proceed up the Valley, along its synclinal axis, we shall find that different rocks successively crop out; each to constitute the surface for a certain space, and then to be succeeded by a deeper, which has emerged from beneath it. We shall also find, that we pass progressively from the very newest to the oldest; though all the formations which lie between these extremes, in all countries, may not be met with. Thus, around the Gulf of Mexico, we begin on broad and deep alluvial deposits; then rise on diluvial or post tertiary, and then on tertiary. To these, in southern Alabama and Mississippi, succeeds a cretaceous deposit, extending into west Tennessee; followed by the coal formations of Illinois and Missouri; then, advancing, we arrive, in northern Illinois and Wisconsin, upon the Devonian shales and sand stones, which underlie the coal basin; then upon the Silurian or transition limestones, sandstones, and slates, and lastly upon granite and other primitive rocks; which stretch northerly

\* Drake. Trans. Amer. Ph. Soc. New Series, Vol. II, 1818.

from Lake Superior to the Polar Sea. To the east and west of the line supposed to have been traveled over, most of these formations spread out with great regularity and amplitude. Thus, there is a geological, not less than a geographical unity, in the Interior Valley. Not the unity of a single formation, existing everywhere, but the unity of one system of formations; deposited on a scale of vast extent, and subsequently subjected to the same influences, whether conservative or destructive. In no other country, over an equal area, is the geological structure so simple and uniform; in no other does it so decidedly constitute the whole into one natural region.

It is an obvious truth, that these formations have undergone but few disruptions, from any force acting beneath. The Ozark Hills of primitive rock in Arkansas and Missouri, have, it is true, been pushed up through the secondary; and, in the former state, there are some volcanic appearances, in the midst of which we find the hot springs of Washita; still further, the great earthquakes of 1811, had their focus in the same quarter. But the whole region is of insignificant extent, compared with the entire Valley, which elsewhere shows scarcely a vestige of volcanic action. If, however, the rock formations of the interior of the continent, still lie in their original position, all that were deposited are not here now. Our best geologists have come to the conclusion, that much has been washed away; that vast submarine currents have swept the continent from north to south; scooped out or deepened the Valley by cutting down its strata; produced the general levelness of its surface, and finally, left upon it the primitive boulders and other drift or post tertiary deposits, which have been described.

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## SECTION V.

### HYDROGRAPHICAL BASINS.

The further study of the physical geography and topography of the Great Valley, or tropico-arctic plain, requires it to be divided into regions, a task of no great difficulty after the descriptions through which we have passed. In the absence of mountain ranges, to serve as natural dividing lines, it becomes necessary to resort to rivers; not, of course, using them as they are employed in designating the boundaries of political states, but referring to their arrangement into distinct basins, and to their confluence in different seas. On this principle, then, we proceed with our analysis.

1. When the eye rests upon the map of North America (*Pl. I.*), it soon perceives where the great water sheds, or lines of division, lie. One of the most important, begins in the Appalachian Mountains, at the northern sources of the Alleghany River, in the state of New York, about north latitude, forty-two degrees fifteen minutes, and west longitude seventy-eight degrees and thirty minutes; whence it proceeds, almost parallel to the axis of Lake Erie, that is, to the south west, until it reaches the forty-first degree;



when it turns northerly, and passing round the head or southern end of Lake Michigan, advances into the region west of Lake Superior; having separated the rivers, which flow into the lakes, from the tributaries of the Mississippi. It has now attained the mean latitude of forty-eight degrees, and, by its inequalities of surface, determines the waters which fall upon it, in three different directions—toward the Gulf of Mexico by the Mississippi, the Gulf of the St. Lawrence by the River St. Louis, and Hudson Bay by Red River. Beyond this, to the west, it is cut through by the synclinal axis, in which we find a point, whence the streams flow to the south and north. It then rises and bears away to the Rocky Mountains, in north latitude fifty-one or fifty-two degrees; separating, in its progress, the Missouri of the south from the Saskatchewan and other rivers of the north. Here then we have a water shed, which, extending from one mountain range to the other, traverses thirty-six degrees of longitude, changes its latitude from forty-two to fifty-two degrees, and cuts off nearly one third of the Valley from the rest. Let us survey it a second time, with a view to its altitudes. Beginning, as before, at the sources of the Alleghany, Concessaw, and Susquehannah rivers, in New York and Pennsylvania, we find in different places, the mountain elevation of this water shed to vary from thirteen to eighteen hundred feet—fourteen hundred may, perhaps, be received as an average. Going westerly, through Ohio and Indiana, it gradually sinks, until, at Chicago, in Illinois, it has fallen to six hundred feet; the elevation of the lake being five hundred and seventy-eight. From this depression it rises as regularly as it had fallen; and on following it to the region west of Lake Superior, at the sources of the Mississippi, we find it restored to its mountain elevation, of from thirteen to seventeen hundred feet. It then sinks, in the synclinal axis, to nine hundred and seventy-five; beyond which it gradually rises, with the great inclined plain, to the Rocky Mountains.

The eastern boundary of this division of the Great Valley is, of course, the Appalachian Mountains, at the sources of the Alleghany, Monongahela, Kenawha, Cumberland, and Tennessee Rivers, round to the state of Georgia; with the low water shed through the western part of that state and the center of Florida; in other words, the eastern limits of this portion of the Great Valley are already defined. The western boundary is the Rocky Mountains.

The greater part of the waters of this extensive region, find their way to the gulf, through the Mississippi; but the rivers of Texas, of the eastern margin of Mexico, of the eastern side of Mississippi, of the whole of south Alabama, of the western margin of Georgia, and the western half of Florida, reach the gulf by their own proper channels. Hence the Mississippi drains but a part of this region, and cannot, properly, give its name to the whole, which I shall therefore call the SOUTHERN, OR MEXICAN HYDROGRAPHICAL BASIN.

II. Starting, as before, from the mountain sources of the Alleghany River, we advance northerly, between them and the sources of the Susquehannah, on

the right, and those of the Genessee and Oswego, of Lake Ontario, on the left. In the valley of the Mohawk, about the parallel of forty-three degrees, the watershed sinks to the height of four hundred and twenty-five feet; but soon rises to the altitude of as many thousands, and winds among the Adirondack Mountains, between Lake Ontario and Lake Champlain; where it separates the waters which flow into those lakes and the St. Lawrence, from those of Hudson River. It is then depressed to one hundred and forty-seven feet, between that river and Lake Champlain; to rise upon the Green Mountains of Vermont, the White Mountains of New Hampshire, and the mountains of Canada East, to their termination at Cape Gaspé, on the Gulf of St. Lawrence; about the latitude of forty-eight degrees north, and longitude of sixty-four degrees west. On the north side of the gulf, it recommences west of Davis' Straits, not far from the sixty-fourth meridian, and fifty-third parallel; and passing south of west, divides the waters of the St. Lawrence from those of Hudson Straits and Bay. Approaching Lake Superior, it winds round the northern curve of that lake (to which it approaches very near), separating its tributaries from the rivers of the southern extremity of Hudson Bay; and continuing to the south west, divides the short rivers which fall into Lake Superior, from the longer which flow into Lake Winnipeg; until it reaches the great culminating center, on which the Mississippi has its origin. From this plateau, round the southern side of the Lakes to the place of starting, on the table land of the Appalachian mountains, the boundary is, of course, that already traced out. The area of this basin is much less than that of the southern or Mexican. As all its waters find their way to the ocean through the St. Lawrence, it may be named the *ST. LAWRENCE HYDROGRAPHICAL BASIN*. Other appellations, however, would be almost equally proper. Embracing so many great lakes, it might be called the *BASIN OF THE LAKES*; and, comprising the eastern portions of the Valley, a term expressing that fact would be appropriate. Extreme precision would adopt *EASTERN* for the whole, and *Lake and St. Lawrence* for its two great divisions.

III. The region which pours its waters into Hudson Bay, extends from the seventieth to the one hundred and fifteenth degree of west longitude; that is, like the Mexican Basin, quite across the Interior Valley; while that last described, is set into one of its sides. The southern boundary of the region which throws its waters into Hudson Bay is, of course, the northern boundary of the two basins just described. Its northern boundary, commencing at the Rocky Mountains, about the fifty-fourth parallel, is the flat watershed, which, running to the north east, separates the waters of the Athabasca River and Lake, on the left hand, and those of the Saskatchewan and Miaminippi, or Churchill, on the right. Turning to the north, about the one hundred and fifth degree of longitude, it divides the waters of Athabasca Lake, and Great Slave Lake, from those of Chesterfield Inlet; after which,

it turns north eastwardly, and gives origin to streams which fall into the Thlewoechok, or Back's River, of the Polar Sea; beyond which, round to Melville Peninsula, it has not been traced; nor has that to the south of Hudson Strait, between the Bay and the coast of Labrador. The width of this region, from south to north, is about twenty degrees of latitude. It may be called the HUDSON HYDROGRAPHICAL BASIN.

IV. The remainder of the Great Interior Valley, constitutes the POLAR HYDROGRAPHICAL BASIN; which includes the whole northern sea coast of the continent, from Baffin Bay to the Rocky Mountains. From the proximity of Hudson Bay on the south, the Polar Basin does not extend far in that direction, until after we have passed westwardly beyond that bay, when it dips south to the fifty-fourth degree of latitude; and embraces the various streams which make up McKeenzie River. Its western boundary is, of course, the Rocky Mountains. Its northern boundary, the Polar Sea, is about the sixty-ninth or seventieth parallel—its longitudes from the ninety-third to the one hundred and thirty-seventh degree; but in estimating its area, we must not forget the great reduction of length in the degrees of longitude within the polar circle, where this Basin has its extreme breadth; still, it is of greater area than the St. Lawrence, though not equal to the Hudson Basin.

We have thus, for the convenience of future topographical description, divided the Great Interior Valley into four natural HYDROGRAPHICAL BASINS:

1. The SOUTHERN, or MEXICAN.
2. The EASTERN, LAKE, or ST. LAWRENCE.
3. The HUDSON.
4. The ARCTIC, or POLAR.

In concluding this general geographical and hydrographical analysis, it may be well to say a word on political jurisdictions. The Southern Basin chiefly belongs to the United States; its south-western portions and extreme southern, to Mexico. The St. Lawrence Basin is divided, almost equally, between the United States and Great Britain. A small part of the Mexican Basin (north of the Missouri) lies within British jurisdiction; while a larger portion of the Hudson, projects into the United States. All the rest of that Basin, and the whole of the Arctic, appertain exclusively to Great Britain. In population, they rank in the order in which they have been named. In proceeding to their topographical analysis, we shall begin with the Southern.



## CHAPTER II.

## THE SOUTHERN HYDROGRAPHICAL BASIN.

## GULF OF MEXICO.

IN proceeding to analyze the Southern Basin, I shall treat, first, of the Gulf; second, of the Mississippi River and its banks; third, of the regions west of the Gulf and River; fourth, of the regions to their east.

The natural relations between the Gulf of Mexico and the Interior Valley of North America, which it limits to the south, are so intimate, that without a preliminary study of the former, no successful progress can be made in the medical topography, hydrology, climate, and endemic diseases of the latter. Beyond this, however, the gulf has claims upon our attention; for the commercial cities, fortresses, and naval stations, which must forever surround it, require that a chapter should be devoted to its description. This I shall do under the following heads — *Position, Form, Area, Depth, Currents, Temperature, Tides, Inundations, and Coasts.*

## SECTION I.

## POSITION, FORM, AND AREA.

The ninetieth meridian west, and the twenty-fourth parallel north, intersect each other very near the center of the Gulf of Mexico, and thus fix its mean latitude and longitude. The extremes of the former are from a little below eighteen to a few minutes above thirty degrees north — those of the latter, between eighty-one and ninety-eight degrees west.

From Cape Catoche, the termination of the peninsula of Yucatan in the south, round to the Rio del Norte, in the west, it washes the coasts of Mexico; on which we find Vera Cruz and Tampico. On that side, the Cordilleras approach it so near, that some of their peaks can be seen from its surface. North east of the Del Norte, it washes the shores of Texas, Louisiana, Mississippi, Alabama, and Florida. Its remaining land limits are the Island of Cuba to the south east. Thus, low lands surround it on every side, except the west. This mediterranean sea has two important connections with the Atlantic Ocean: one on the south by the Strait of Yucatan, between Cape Catoche and Cape Antonio, where it opens into the Caribbean Sea; the other on the east, by the Strait of Florida, between Cape Sable and Havana.

In reference to the terrestrial zones, it is divided almost equally between the torrid and temperate.

Its figure rudely approaches a broad, irregular oblong. Its north and south sides are pressed toward each other, near their middle, by the delta of the Mississippi and the promontory of Yucatan, a line from one to the other being the shortest by which it can be crossed.

Its area, if we take seven hundred miles for its average width, and one thousand for its mean length, is seven hundred thousand square miles. It may be more or less, but exactness on this point is not required, for all demands of our object are satisfied, by knowing that immediately south of the Interior Valley there is an extensive body of warm water.

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## SECTION II.

### DEPTH.

The following statement of facts bearing on this point, has been sent me by Lieutenant Maury, of the Hydrographical Office, Washington:—"Little is known as to the depth of the central part of the Gulf, except that it is beyond the usual reach of the "deep sea lead"—say one thousand feet. There is a belt of soundings all around the Gulf, varying in breadth from a few miles to one hundred and forty or one hundred and fifty. For example: north of Cape Oatoche the water gradually deepens for one hundred and forty miles, until no bottom is reached at one hundred and ninety-eight fathoms. So, also, from the Tortugas one hundred and eighty miles to the north east, it deepens, from sixty fathoms near those islands, to no bottom with a line of one hundred and sixty-two fathoms; which point is also about one hundred and eighty miles from the nearest point of the Peninsula of Florida. So, too, south of Appalachicola the shoal water extends off two hundred and fifty miles to soundings of one hundred and twenty fathoms. With these exceptions, if you will draw a line parallel to the shore, and about fifty miles from it, entirely around the Gulf, this line will run along in about two hundred feet of water."

Thus the bottom near the shore of the Gulf presents the junction of two curved inclined planes, an earthy and an aqueous;—a mechanism which suggests that a process of filling up has long existed, and may still be going on. At the same time, the entire bed may be rising. Admitting these operations, we may say, that the former leads to extension of the land; the latter, to recession of the waters. And that a change in the relative levels of the two has taken place within a modern (geological) period, is rendered certain, from the existence of long, low banks of recent marine shells, which lie (in various places near the shore), several feet above the present level of the water. At what ratio this process has been carried on, or is now proceeding, is unknown.

## SECTION III.

## CURRENTS.

It is held as a fact, by marine hydrographers, that the trade winds, from the coast of Africa to that of South America, by acting on the surface of the Atlantic Ocean, impede its movement to the east, in the direction of the earth's rotation; and thus cause an accumulation of the retarded water against the American continent, between the tropics, whence it flows off laterally. The currents to the north are all that demand attention from us. These, following the coast of South America, enter the Caribbean Sea by the Windward Islands, and traversing that sea, south of Hayti, Jamaica, and Cuba, pass through the strait between the latter island and the promontory of Yucatan, into the Gulf of Mexico. Humboldt recognizes this current as a reality; and Lieutenant Browning\* informs me that the evidences of it are conclusive. *First.* In traversing those straits and the Caribbean Sea, south of Cuba, a ship's dead reckoning requires an allowance of half a mile an hour for a westerly current. *Second.* When ships depart from Jamaica for England, they prefer to sail to the west, and make a *detour* through the Gulf of Mexico, round the Island of Cuba; thus keeping with the current, which more than compensates for the increased length of the voyage. It would appear, however, that the tropical water, thus introduced from the Caribbean sea, does not make a circuit directly round the west end of the Island of Cuba, to the Havana and Florida Straits; but is diffused through the Gulf, performing in it a kind of circuit, and at last issuing through the straits just mentioned, as the well-known and celebrated Gulf Stream. On this point Humboldt holds the following language:

"The coast of Mexico, along the Mexican Gulf, may be considered as a dyke, against which the trade winds, and the perpetual motion of the waves from east to west, throw up the sands which the agitated ocean carries along. This current of rotation runs along South America, from Cumana to the Isthmus of Darien; it ascends toward Capo Catocho, and, after whirling a long time in the Mexican Gulf, issues through the Canal of Florida, and flows toward the Banks of New Foundland. The sands heaped up by the vortices of the waters, from the Peninsula of Yucatan, to the mouths of the Rio del Norte and the Mississippi, insensibly contract the basin of the Mexican Gulf. Geological facts, of a very remarkable nature, prove this increase of the continent. We see the ocean everywhere retiring. M. Forrer found, near Sotto la Marina, to the east of the small town of New Santander, ten leagues in the interior of the country, moving sands filled with sea shells. I myself observed the same thing in the vicinity of Antigua and New Vera Cruz. The rivers which descend from the Sierra

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\* United States Navy.



Madro, and enter the Atlantic Ocean, have in no degree contributed to increase the sand bank." \*

*Further:* Lieutenant Maury, of the Hydrographical office, Washington, writes me on this subject as follows:

"The current from the Caribbean sea, after passing the Yucatan Strait, varies in force and direction, so as often to produce many eddies and counter currents. Still, my own opinion is, that, for the most part, it performs the circuit of the Gulf; but not in any well-marked or constant channel. In corroboration of this I would mention the tides at Vera Cruz, for instance, which ebb and flow once in twenty-four hours at ordinary times; but which sometimes flow continuously to the north west, and at other times to the south east, for three or four days together; sometimes, again, there is neither rise nor fall for several days."

*Again:* The course of the Mississippi, from the mouth of the Ohio River to its termination at the Balize, seems to throw some light on this subject. For eight or nine hundred miles, its bearing is west of south, but when it reaches the vortex of its delta, at the mouth of Red River, it turns so far to the east, that, in flowing through two degrees of latitude, it makes nearly two degrees and a half, or one hundred and fifty miles, of longitude.

Now, by what agency has the direction of the river been turned and kept to the east, ever since it reached the Gulf at the mouth of Red River, and began to deposit that silt, of which the delta is composed? Has not a gentle circumferential movement of the gulf waters carried the silt in an eastern direction, while it was subsiding? Such a movement, however slow, would of necessity cause the deposits to fall where we now see them; that is, give to the delta and the new river bed, precisely the form and direction which they exhibit. The assumed cause explains the phenomena, and may therefore be admitted as a reality. If the river bed, on entering the gulf, turned to the west, we should certainly regard it as evidence that no currents flow from that direction.

*Finally:* Lieutenant Browning informs me, that, near the eastern margin of the Gulf, from the Tortugas and Key West, round to Pensacola, or even to the Balize, there is a gentle current from south to north. This is evidently an eddy, and implies a stronger current in the opposite direction; from the delta of the Mississippi, to the extensive reef which projects into the Gulf from Cape Florida to the Tortugas. Impinging against this reef, a part of the water is returned to the north, along the coast of Florida, while the remainder makes its way through the straits between that peninsula and Cuba, constituting the Gulf Stream.

Although we regard this Stream as depending essentially on the oceanic movements which have been described, we must not overlook the contributions to the Gulf, made by the rivers which enter it. Very little of this supply is furnished by the countries lying around the southern semicircle of the gulf,

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\* Pol. Essays on New Spain. Vol. I, B. I, Chap. III. p. 62.

for all the rivers of western Cuba, of the Peninsula of Yucatan, and of that portion of the Republic of Mexico, which lies between it and the mouth of the Rio del Norte, near the latitude of twenty-six degrees north, are very short. If, however, the river supplies are almost limited to the northern half of the Gulf, they are still much greater, relatively to its area, than those received by closed seas generally, or by the universal ocean; for that portion of the continent from which they are derived, is nearly three times as great as the surface of the Gulf; thus reversing the proportions of land and water of the globe, taken as a whole.

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## SECTION IV.

### TEMPERATURE.

As all the rivers of the Gulf, from the Rio del Norte to the Chattahoochee, flow from higher latitudes than those in which they mingle with its waters, (some of them, indeed, as the Missouri, from nearly twenty degrees further north), and as their sources are from five hundred to ten thousand feet above the Gulf, the water they throw into it has, of course, a temperature which must, to some extent, reduce that of the water with which it mingles. In the absence of more important observations on this point, I may be allowed to state the following: On the 13th of March, 1843, I found the temperature of the mouth of the Mississippi forty-four degrees, Fahrenheit. Five miles beyond the bar of the South West Pass, the river water, distinguishable from that of the Gulf by its turbidness and yellowish tint, was still the same in temperature; but that drawn up from a depth of sixty feet, being brackish and less turbid, was fifty-one, or seven degrees warmer. The temperature of the earth in that latitude, twenty-nine degrees north, is, however, about seventy, or nineteen degrees greater; showing that the Mississippi had exerted a cooling influence to an unascertained depth. Passing laterally out of this river current, to the distance of a few miles, in the midst of transparent salt water, I found the temperature at the surface fifty-seven degrees. Soundings were not made at either station; but as they were at the same distance from the shore, and the bottom is known to be an inclined plane, the difference between forty-four and fifty-seven degrees (thirteen) was undoubtedly attributable to the Mississippi. To what distance in the Gulf that difference extends, is unknown; but it is by no means as far as it would be, if the river discharged itself by one mouth instead of several.

These observations were made, however, when the river water had its minimum temperature. In the latter part of summer and in early autumn, it attains to more than seventy degrees; when its cooling effect is nearly or quite nullified. A few days after these observations were made, I found the surface of Lake Pontchartrain and Lake Borgne—shallow bays of brackish water, lying nearly a degree further north—to be fifty-six and fifty-five de-

greos. It is worthy of remark, that no river of any size enters the former; while the small rivers, Pearl and Pasengouln, discharge their waters into the latter; which, therefore, although a little further south, was one degree cooler. On the same voyage, I found the temperature outside of Dauphin Island, in the open Gulf, but in shallow soundings, fifty-six degrees; in ascending Mobile Bay, half a degree north of Lake Borgne, fifty-two degrees; and at the dock in Mobile, forty-nine degrees and a half. As the Alabama River, the largest tributary of the Gulf east of the delta of the Mississippi, discharges its waters into this Bay, we have additional evidence of the cooling effect of river water, in the sinking of the thermometer from fifty-six to forty-nine degrees and a half, in a distance of fifty miles. In 1844, April 10th, I found the heat of Lake Pontchartrain sixty-nine degrees; that of the Gulf, off Dauphin Island, seventy degrees; and that of Mobile Bay, sixty-five degrees, or four below that of Pontchartrain;—still showing the river influence.

But, of course, all the cooling of the northern margins of the Gulf is not referable to the influx of river water; for the winter exerts its influence, and with so much greater effect, as the waters are shallower. Still, the facts which have been cited demonstrate, that the atmospheric influence is reinforced by the fluviatile; and at certain times, when the mountain winds, called "northera," descend and sweep over the Gulf with great velocity, for several successive days, their cooling influence on the shallow waters of the Gulf is decisive, even as far south as Key West. I was assured, by the late estimable Commander Johnston, U. S. N., that when stationed on that coast, he had seen many of its fish benumbed, and even destroyed, by one of these long continued and violent winter tempests, acting on the shoal waters of the Florida Reef.

At what period of the year the cooling influence of the northern rivers and the northern winds, effects the greatest reduction of the temperature of the shallow waters of the Gulf, is not known; but from various considerations, we may fix the minimum between the end of February and the vernal equinox. If this be correct, the observations made in February, 1843, give us the minimum heat of the shallow waters, from the mouths of the Mississippi to Mobile Bay, inclusive, and the scale is, forty-four, forty-nine and a half, fifty-two, fifty-five, fifty-six, and fifty-seven degrees, according to the saltness, not the depth, of the water.

At what period of the year do the waters of the Gulf attain their maximum heat? This is not known, but in all probability, it is not far from the autumnal equinox. The following observations show, imperfectly, the ratio of increasing vernal temperature near the shore.

Dates.	L. Pontchartrain.	Lake Borgne.	Gulf.	Mobile Bay.
1843, March 13	56°	55°	56°	59°
1844, April 10	69°		70°	65°
" " 24			70°	80°



From these numbers it appears, that the rise of Gulf temperature in the spring, is at the rate of half a degree a day.

If the northern portions of the Gulf are cooled by these river currents, the southern are warmed by the great marine current, which enters it from under the equator, through the Strait of Yucatan. Under these influences, the temperature, in traversing it from north to south, ought to rise more rapidly than it would from the mere influence of climate; but we are in want of observations on this point; and, indeed, I have not been able to collect many experiments on the temperature of any part of the Gulf, beyond the limits just given. For the following, I am indebted to Lieutenant Maury, of the Hydrographical Office, Washington.

SURFACE TEMPERATURE OF THE GULF OF MEXICO.

Name of vessel.	Where from.	Where found.	Month.	Tem. of water.	
				Min.	Max.
Vandalia,	Pensacola,	Havana,	Nov. and Dec.	72°	82°
Falmouth,	Havana,	Key West,	November,	76°	81°
Falmouth,	Pensacola,	Vera Cruz,	October,	78°	82°
Falmouth,	Vera Cruz,	Tampico,	December,	74°	76°
Falmouth,	Pensacola,	Mouth of Mississippi,	February,	57°	64°
Falmouth,	Vera Cruz,	Pensacola,	March,	59°	75°
Mississippi,	Key West,	Pensacola,	August,	81°	86°

The value of these observations would be much greater, if the latitudes, distances from land, and depths of water, had been noted. The highest among them is eighty-six degrees, in the month of August, north of Key West. Mr. Lyell\* has quoted from Major Rennell, another observation of the same amount; but in what latitude it was made is not stated. If we receive them as correct, we may conclude that the heat of the middle and southern parts of the Gulf, is several degrees higher than that of the Atlantic Ocean in the same parallels; a difference attributable no doubt to the introduction of tropical waters from the Caribbean Sea.

The existence, to the south of the Great Interior Valley, of this immenso basin of tropical water, having a temperature several degrees higher, than if the strait between Yucatan and Cuba had (no existence, is a hydrological condition, which deserves the attention of the meteorologist and otologist of the Valley. If it were replaced by land, our south and south-west winds, in winter and spring, would fall far short of producing those thaws which, at present, they infallibly occasion, even in Canada, if they continue to blow for a few days. Taken in connection with the Rocky Mountains, it also explains the surprising reduction of temperature which follows on a change in the course of the wind, from a few points south of west, to a few points north of west; by which, currents that have passed over the warm surface of the

Gulf, are replaced by currents from the snowy summits of those mountains. The physician will also perceive, that those who navigate the Gulf, or reside on its coasts, must, forever, be liable to the diseases which properly belong to the most southern climates.

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## SECTION V.

### TIDES AND INUNDATIONS.

I. **TIDES.**—Along all the northern coasts of the Gulf the tides are of inconsiderable height; especially in the rivers, where they are less than in the heads of small bays and inlets. In the mouth of the Mississippi, I was told by Captain Arnable, the observing commander of the towing steamer, *Phoenix*, that they ordinarily rise about a foot, the weather being calm. At new and full moons, they reach eighteen inches. Mr. Parker, an intelligent pilot, made three months of daily consecutive observations, at the Balize, in the South East Pass, having devised for the purpose a graduated scale. The highest, during that period, was thirty-three inches; the lowest less than a foot. When the Mississippi is low, the tide is said sometimes to manifest itself above New Orleans; the water, of course, being fresh. At Mobile, Mr. Troost, civil engineer, estimates their average height at a foot. At Tampico, to the south west, they rise, however, as Lieutenant Browning informs me, to the height of four feet.

II. **INUNDATIONS.**—A gale, to or from the land, may raise the tides to double their ordinary height, or prevent them altogether, according as it promotes or opposes them. A tempest sometimes drives the waters up the rivers, and over the lowlands, creating a deluge. At the Balize, there is a tradition that in the month of August, 1812, the water at Port St. Phillips (*Pl. V*), thirty miles up the Mississippi, rose nine feet in half an hour; the Balize was, of course, inundated, and every cabin half way to New Orleans was removed from its foundation blocks. In August, 1831, the same place experienced another visitation. For several days preceding it, the reflected light of the sun displayed a greenish tint; showing a peculiar condition of the atmosphere. The 10th was rainy, with gusts. At night, the wind became suddenly fixed from the east; and blew with the utmost violence. On the 17th it continued, with copious rain, from clouds which hung very low; and, by night, the inundation was at its height. Nearly all the people of the village were driven to their boats. The rise was many feet. These facts were given me by Mrs. Anderson, an observing lady, long resident at the Balize.

In Mobile Bay, on the 18th of October, 1841, as Mr. Troost informed me, a south wind, of five days' continuance, raised the water nine feet four inches; and, on the 4th of March, 1842, another, of ten days' duration, heaped it up several inches higher.

The isthmus on which New Orleans is built, suffers occasional deluges of the same kind, from Lake Pontchartrain, which convert the cypress swamps in the rear of the city, into deep ponds, and even flow over many of the streets.

In Pensacola Bay, the fury of the waves is directed upon the long, narrow dune of white sand, called Santa Rosa Island (see Pl. III), which they mount over, but falling into the Bay and Sound which lie in its rear, do no mischief.

Similar inundations are occasionally experienced, from the same cause, on the islands of Galveston and Key West.

In short, they occur throughout the whole coast, for everywhere it lies so low as to permit them: But they never happen in many places at the same time; for a wind which may occasion them at one locality, might blow the water from another.

The low shores of the Gulf must forever remain liable to these deluges, and of course they will always abound in pools and marshes.

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## SECTION VI.

### COASTS.

What has been said on the shoal waters and inundations of the Gulf, will suggest the general character of its coasts — *everywhere low*. From Vera Cruz around to Cape Florida, there is not a single league of rocky, or iron-bound shore; nor any other harbor equal to that of Pensacola, the entrance to which is through water only twenty-four feet in depth. Everywhere the tides and waves fluctuate on sloping beaches of sand or silt; the latter being present, however, only at the mouths of rivers; and where it can be kept in place by the roots of grasses. The sand is generally white, and so fine as to be readily moved by the waves, or drifted by the winds. By these agents, dunes of irregular and ever-changing forms are built up; some of which constitute peninsulas, while others are severed from the main land, and converted into crescent islands. The watery surface is not less diversified than the earthy. Numerous creeks and bays of every size and form, lagoons, ponds, swamps, and marshes, are intermingled with the earthy deposits and drifts; and present, throughout a terraqueous margin; which sufficiently indicates that the surrounding continent is advancing upon the Gulf. Some of the pools and marshes consist of fresh water; others are brackish; others almost as salt as the Gulf itself. In some places there are long, navigable sounds, or lagoons, between the main land and the dunes or sand islands.

The principal bays are, Tampa, Appalachicola, Pensacola, and Mobile, to the east of the delta of the Mississippi; and Galveston, Matagorda, Espiritu Santo, Corpus Christi, Aransas, and San Antonio, to its west.



Besides these, smaller bays and lagoons are numerous. In reference to the western coast, Humboldt observes—

"The shore of the provinces of Santander and Texas, from the twenty-first to the twenty-ninth degree of north latitude, is singularly festooned, and presents a succession of interior basins from four to five leagues in breadth, and from forty to fifty in length. They go by the name of lagunas, or salt-water lakes. Some of them (as the Lake de Tamalinga) are completely shut in; others (as the L. Madre and the L. de San Bernardo) communicate by several channels with the ocean."\*

Rivers enter the heads of many of the bays, and are filling them up with silt, in proportion to the extent and looseness of the surfaces which are drained. Of the whole, the Mississippi is the only river which has accomplished its work; having not only filled up its bay, but built up land from the bottom of the open sea;—an achievement which has resulted from its commanding the resources of a larger portion of the continent, than all the other rivers from Cape Florida to Vera Cruz. A striking and instructive effect has resulted from the partial filling up of many inlets. Their shores opposite the river deposits, are everywhere more infested with autumnal fever, than further down their estuaries, near the Gulf, where their banks and bottoms abound in sand derived from the margins of the tertiary or post-tertiary plain, which surrounds the Gulf. Beneath these deposits, on the eastern side of the Gulf, wherever rocky strata are to be found, they belong to the tertiary formations, and consist of friable lime and sand stones.

These general descriptions are applicable to the coasts of the Gulf east and west of the delta of the Mississippi; but do not apply to that immense alluvial deposit, which requires to be described separately; that description, however, must be given in connection with both the Gulf and River; and will, therefore, be deferred until we have examined the principal localities of the coast.

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\* New Spain, Vol. II, p. 185.

## CHAPTER III.

## THE SOUTHERN BASIN, CONTINUED.

## SPECIAL MEDICAL TOPOGRAPHY OF THE COASTS OF THE GULF OF MEXICO.

IN proceeding to describe such localities as are of interest to the physician, a question of limits arises. Shall we take those places only which stand upon the Gulf, like Vera Cruz and Pensacola, or ascend the rivers which enter it, as far as settlements have been made upon them? The answer must be, that the former would be too restricted, and the latter too extended. I shall, therefore, take the intermediate limits of tide water, which will carry us to the heads of the river estuaries and of the little bays; and enable us to embrace, in the zone of the Gulf coasts, such localities as Fort Brooke and Mobile. In entering on this, the beginning of our medical topography, I propose to start with the most southern locality, Vera Cruz, on the western side of the Gulf, and travel north to the delta of the Mississippi; then, to begin anew, at the most distant point in the south, Havana, and travel northerly to the same delta.

## SECTION I.

## VERA CRUZ.

VERA CRUZ, the most populous town and the commercial metropolis of the Republic of Mexico, and the largest city of the western Gulf coast, has at all times been an object of interest, with the medical etiologist; and yet I have not met with the materials for a satisfactory description.

Its latitude is  $19^{\circ} 11' 52''$  N., longitude  $90^{\circ} 8' 45''$  W. It was founded by the Spaniards near the close of the sixteenth or in the beginning of the seventeenth century, about two hundred and fifty years ago; on the spot where Cortes first landed for the conquest of Mexico.\* We are indebted to Humboldt, for a sketch of its topography.

"It is situated in an arid plain, destitute of running water, on which the north winds, which blow with impetuosity from October until April, have formed hills of moving sand. These downs (*Meganos de Arena*) change their form and situation every year. They are from eight to twelve meters (twenty-six to thirty-eight feet) in height, and contribute very much, by the reverberation of the sun's rays and the high temperature which they acquire during the summer months, to increase the suffocating heat of the air of Vera

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\* Clavigero's History of Mexico, Vol. II, p. 296.

Cruz. Between the city and the Arroyo (Avilan, in the midst of the downs, are marshy grounds covered with mangles and other brushwood. The stagnant water of the Bajío de la Tombladera, and the small lakes of El Horniga, El Rancho de la Mortalaza, and Arjona, occasion intermittent fevers among the natives. It is not improbable that it is, also, not one of the least important among the fatal causes of the *vomito prieto*, or yellow fever. All the edifices of Vera Cruz are constructed of materials drawn from the bottom of the ocean, the stony habitation of the Madreporas (piedras de Mucara), for no rock is to be found in the environs of the city." "Water is found on digging the sandy soil of Vera Cruz, at the depth of a meter (3.8 feet); but this water proceeds from the filtration of the marshes formed in the downs. It is rain water, which has been in contact with the roots of vegetables; and is of a very bad quality, and only used for washing. The lower people (and the fact is important for the medical topography of Vera Cruz) are obliged to have recourse to the water of a ditch (*zanja*), which comes from the *meganos*, and is somewhat better than the well water, or that of the brook of Tonoya. People in easy circumstances, however, drink rain water collected in cisterns, of which the construction is extremely improper, with the exception of the beautiful cisterns (*algibes*) of the castle of San Juan d'Ulloa, of which the very pure and wholesome water is only distributed to those in the military. This want of good potable water has been for centuries looked upon as one of the numerous causes of the diseases of the inhabitants."\*

Such was the situation of the city, in 1803. Forty-two years afterward, A. D. 1845, when visited by Norman, it was not materially different, except that the population, which Humboldt stated at more than sixteen thousand, is given by Mr. Norman at six thousand. "The form of the city is semi-circular, fronting the sea. It is situated on an arid plain surrounded by sand hills, and is very badly supplied with water,—the chief reliance being upon rain collected in cisterns, which are often so poorly constructed as to answer but very little purpose. The chief resource of the lower classes is the water of a ditch, so impure as frequently to occasion disease." "The outside of the city looks solitary and miserable enough. The ruins of deserted dwelling houses, dilapidated public edifices, neglected agriculture, and streets once populous and busy, now still, and overgrown with weeds, give an air of melancholy to the scene, which it is absolutely distressing to look upon."† Mr. Thompson informs us that there are large swamps in the rear of the city.‡

The castle of San Juan d'Ulloa, stands upon and nearly covers a rocky island, in front of the city.

According to Humboldt, the rich merchants of Vera Cruz, at the time of

\* Politt. Es. on New Spain, Vol. II, p. 175.

† Notes of Travel, p. 90—96.

‡ Recollections of Mexico.





his visit, had summer residences at the interior town of Jalapa, four thousand feet above the Gulf; where they enjoyed a "cool and agreeable retreat, while the coast was almost uninhabitable from the mosquitoes, the great heat, and the yellow fever." That disease, it is well known, prevails in Vera Cruz every year; suspended, or nearly so, during the winter, but returning after the vernal equinox, with as much certainty, as intermittents and remittents recur, before the autumnal equinox, along the rivers of Illinois, or Alabama. According to Humboldt, it never extends into the country. It may be collected from him, that intermittents also occur in Vera Cruz, and at other places along that coast; but to what extent, I cannot discover; nor whether a disease, answering to the remittent autumnal fever of the more northern portions of the Valley, and distinguishable from yellow fever, is met with there.

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## SECTION II.

### TAMPICO.

At the distance of about two hundred miles north-north west from Vera Cruz, in the state of Tamaulipas, we have the Mexican town of Tampico. Its position, in  $L. 22^{\circ} N.$ , is on the left or northern bank of the River Panuco, immediately below the junction of the River Tamiseco, and six miles from the Gulf. These rivers, which resemble deep and winding canals, descend from the Sierra Madre, or eastern range of the Cordilleras; and traverse the broad, flat, and fertile zone, which surrounds the western segment of the Gulf. The Panuco flows from the south west, and the Tamiseco from the north west. The interior, mountain city of San Luis Potosi, stands on the head waters of the former. Between these rivers, and also to the north and south, there are long, narrow lakes, running nearly parallel to the Gulf Coast, with many communications between them and the rivers. The region around Tampico is not, like that around Vera Cruz, a vast field of drifted sand; but is covered with a productive soil, and a luxuriant, natural or cultivated vegetation. The town is built on a bold and rocky bank, above high water mark, without any intervening foul beach, as the deep water extends to the foot of the bank. In its rear, to the north and north-west, the ground remains wet for a while after great rains; but there are in that quarter no permanent ponds. To its west, between the two rivers, there is a lake marsh, and on the further or south side of the river, the head of a narrow lake which stretches off to the south.\*

TAMPICO is the most important town on the western side of the Gulf, between Vera Cruz and Galveston. The country in its rear is attractive to agriculturists; the rivers which traverse it, facilitate communication with

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\* Norman: *Rambles by Land and Water*, 1845.—Lieutenant Browning, U. S. N.

the interior; and the harbor itself is more accessible than most others on the western side of the Gulf. The commercial intercourse between this place and New Orleans, always considerable, is likely, hereafter, to be so much greater as to give to its medical topography a decided importance. From Lieutenant Browning, I learn that intermittent fevers prevail, especially in spring; but as the summer comes on, they are merged in yellow fever, which, as at Vera Cruz, may be regarded as the great and never failing endemic.

### SECTION III.

#### GALVESTON ISLAND AND TOWN.

This is at once the name of a bay, an island, and a new American city, of the state of Texas. The *Bay* has the form of an irregular parallelogram; with one end on the Gulf, and the other forty miles north, in the country. The San Jacinto enters its north-west, and the Rio Trinidad, or Trinity River, its north-east corner. Its width is from twelve to eighteen miles, with an average depth of nine or ten feet; reduced to five or six, over Red Fish bar, which bisects it into nearly equal parts.

The *Island* lies with its eastern half immediately in front of this bay, within a mile of the main land; and extends west south-west, in a straight line, to a length of thirty miles, with a breadth of four or five. The harbor is between the eastern end of the island and the mouth of the bay, with an entrance from the east.\* At the entrance of the bay, there is a low, flat island, containing about one thousand acres, which, with Bolivar Point, a promontory of the main land, limits the harbor to the north. Galveston island is but a compact bed of drifted sand, rising a few feet above the level of the Gulf, and liable to partial inundation, from the fluctuations produced by strong southern and eastern winds.

The *City*, of which the Lat. is  $20^{\circ} 18' N.$ , and Lon.  $96^{\circ} 6' W.$ , stands adjacent to the harbor, on the north side of the island. Near the water's edge, in front of the former, the surf has thrown up a levee of sand and shells about two feet high in its center, and one hundred feet broad; immediately in the rear of which, is a broad depression, so low that high tides run into it, and rain water accumulates, so that it presents either a marsh or a sheet of water, three-quarters of a mile long, and from one to three hundred feet broad. The principal business street, called the Strand, runs upon this natural levee; and on the south side are the warehouses, which run back over the morass, which receives their filth. The rest, and more interior portions of the city, are built on a dry and porous soil, and present an aspect of cleanliness and comfort.†

\* Texas, by Mrs. Mary Austin Holley, 1836, p. 26.

† An account of the Yellow Fever, which appeared in the city of Galveston, 1839: by Ashbel Smith, M. D.



Until about 1830, Galveston island was uninhabited; in 1837, the emigration to it, from the United States, became active; in 1880, the city contained from two thousand to two thousand five hundred inhabitants, and the number has been increasing ever since. Galveston has experienced several invasions of yellow fever, when that disease was epidemic in New Orleans. It is also liable to the common forms of autumnal fever.

Between Galveston and the delta of the Mississippi, there is no coast locality of interest, and in pursuance of the plan already announced, we must now transfer ourselves to the eastern side of the Gulf.

## SECTION IV.

### HAVANA, AND THE ISLAND OF CUBA.

Although the Island of Cuba makes no part of the Interior Valley of North America, the relations between them are so intimate, that the medical historian of the latter, should include the former in his descriptions.\* These relations are three fold: 1. The meteorology of Cuba gives us a tropical starting point for tabular views of the climates further north. 2. It is impossible to study the yellow fever of the northern shores of the Gulf, without a reference to the city of Havana. 3. That city and the island to which it belongs, are the chief places of resort for those invalids of the Valley, who seek a southern winter residence.

*Cuba* is a long, narrow island, lying nearly east and west, between the latitudes of twenty and twenty-three and a half degrees north. Its extremities and center are elevated and broken; in fact, may be regarded as a mountain of the sea. The greatest heights are in the eastern extremity of the island, where the Pico de Tarquino rises to the altitude of eight thousand four hundred feet.

But as this portion of the Island lies in the seventy-seventh degree of west longitude, it is too remote from the Gulf of Mexico and the coast of Florida to exert any perceptible effect on the climate of either. The Island, moreover, presents its extremity instead of its side to the Gulf, which greatly reduces the influence it might otherwise exercise. Intermittent fever, but not yellow fever, prevails along the rivers of Cuba.†

HAVANA (*Pl. I*) stands on the northern margin of the island, near its western extremity, in N. Lat. 23° 9' 27", and W. Lon. 82° 22' 53", about one hundred miles from Cape Florida. A capacious harbor, with high, rocky portals, washed by the Gulf Stream, abounds in shipping, at all seasons of

\* I have not been able to meet with any full description of the medical topography of Havana; and the account which I expected from a highly intelligent medical friend, once resident there, has not come to hand.

† Notes on Cuba. By a Physician.



the year except the hottest. The city stands on a plain, which lies on the western side of this harbor, and is surrounded by hills.\* In one corner of the plain, near the harbor, there is a swamp, the exhalations from which are wafted over the city and shipping. The streets are narrow, and kept passably clean.† Its settlement was begun by Spain, in 1519. Its commerce is with nearly all the civilized world. Ever since the yellow fever attracted attention, or was recognized as a distinct disease from the remittent autumnal fever of the temperate zone, it has prevailed as an endemie of Havana, raging epidemically from April until December, and occurring sporadically throughout the remainder of the year. Thus, in reference to that fever, Havana and Vera Cruz are in a manner identical; and in almost every alleged case of its importation into New Orleans, one or the other of those cities has been assigned as its source. If Havana have been accused more frequently than Vera Cruz, it was because of the greater amount of commercial intercourse, and the shorter time required for the voyage.

## SECTION V.

### KEY WEST.

The water shed or central swell of Florida, which, on the confines of Georgia, in the thirtieth parallel, has the altitude of one hundred and fifty or sixty feet, gradually subsides, and after passing the latitude of Tampa Bay, twenty-seven degrees thirty minutes north, is no longer obvious.‡ Thence to Cape Sable, the southern extremity of the Peninsula, the surface continues to sink, and at that point, disappears beneath the sea. Its submergence, however, is imperfect, and to the south-west for nearly two hundred miles, there is a series of reefs and keys, || the most distant of which are the Portugas, or Turtle Islands. The basis of this chain of shoals and low islands, is tertiary limestone, with superimposed beds of sand, shells, and corals. In a hygienic, or medical point of view, there is but one of the whole series, which deserves attention, and that is —

*Key West (Pl. I.)*, formerly called *Thompson's Island*. In position, this Island is about forty miles south-west of Cape Sable, the southern extremity of Florida, and between eighty and ninety north of Havana, with the Gulf Stream rolling between. It makes a part of the distinguished and dreaded Florida Reef, on which so many vessels have been wrecked. Its greatest

\* Norman: *Rambles by Land and Water*.

† *Adventures in Mexico and the Rocky Mountains*. By George F. Ruxton, Esq. 1848.

‡ *Bradford's Illustrated Atlas*, p. 139.

|| *Cayos, Rocks, Sp.*

length from east to west is seven miles, with an average breadth of two. Its elevation varies from that which permits an overflow by ordinary tides, up to ten feet; the greater portion, however, not rising above six or seven. The surface of the Island presents many marshes and shallow basins, filled during the rainy season with fresh water; which, although imbibing from the soil, or receiving from the spray of the Gulf, sufficient salt to render it brackish in the dryer portions of the year, is the most potable which can be obtained in the Island. The surface has a layer of soil supporting an herbaceous vegetation, and shaded by a growth of small trees and shrubs.\* Several years ago, Commander McIntosh, U. S. N., while stationed at Key West, had (as he informed me) a number of vistas cut through this jungle, along which he dug ditches, and allowed the tides to flow into the marshes, and the fresh water of the great rains to flow out; whereby the salubrity of the Island, as he believed, had been greatly increased.

Occasionally, the waves throw upon the shores of the Island an immense quantity of sea weed, enveloping mollusca and other marine animals; the decomposition of which, under the action of an almost tropical sun, adds greatly to the deleterious qualities of an atmosphere, already impure from more permanent causes.† These deposits are made under the influence of agitating winds, which are sometimes so violent as to drive the waves over the whole Island, and produce great devastation. The chief settlement of the Island is the town, harbor and military post of—

KEY WEST, in N. Lat.  $24^{\circ} 33'$  and W. Lon.  $81^{\circ} 52'$ . For a while, this was the principal naval station of the United States for the Gulf of Mexico. It has ever since been a military post. The inhabitants of the town consist largely of wreckers, or persons engaged in saving the crews and cargoes of vessels wrecked on the Florida Reef.

Yellow fever prevailed at this place, as an epidemic, at the time it was a naval station; but is not an annual visitant, as it is of Havana, ninety miles further south. According to the army returns, autumnal fever is not very prevalent. The average ratio of intermitting fever is twenty per cent.—of remitting fever two per cent.‡ It can scarcely be doubted that additional attention to the surface of the Island would render it, for a southern locality, highly salubrious.

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\* Dr. Morgan: Phil. Jour. of the Med. and Phys. Sci. Vol. viii, p. 54.

† N. Amer. Med. and Surg. Jour. Vol. iii, p. 24.

‡ Med. Statist. U. S. Army, 1840.

## SECTION VI.

## TAMPA BAY, AND FORT BROOKE.

TAMPA BAY (*Pl. I*) extends in a north-east direction, about thirty-five miles into the peninsula of Florida. It bifurcates into heads; the larger of which, to the west, having no rivers, and being, as yet, nearly destitute of inhabitants, may be dismissed from further notice. The other receives the Alafia, an inconsiderable stream; and the river Hillsboro', which, at its mouth, is one hundred and thirty yards wide; though but a few miles up, it is so contracted, that a steamer can with difficulty turn in its channel.

There are oyster beds at its junction with the Bay, and, of course, no alluvial deposits. To the east, between it and the Alafia, there are some low wet grounds, and actual marshes; but its banks and the coast to its west, are dry and sufficiently elevated, bearing open forests of pine and scrubby oaks—the former predominating on its right bank, the latter on its left.\*

FORT BROOKE, N. Lat.  $27^{\circ} 57'$  and W. Lon.  $82^{\circ} 35'$ , stands on the east bank of the estuary of Hillsboro' River.

It has been regarded as a highly salubrious post. Yellow fever has scarcely ever invaded it. The ratio of remittent fever is nine per cent.—that of intermittent, seventy-three per cent. The high ratio of the latter disease has not, however, destroyed the character of this post, with our army surgeons; who have observed that a large proportion of the cases were contracted elsewhere, when the troops were on detached service.†

Tampa Bay affords the best harbor south of Pensacola; and, since the termination of the Seminole war, settlements have begun upon its banks, which at no distant period may render it an eligible winter residence for invalids—the most southern to be found on the Peninsula of Florida.

## SECTION VII.

## PENSACOLA: THE BAY AND TOWN.

I. The beautiful Bay of PENSACOLA, in the state of Florida, is connected with the Gulf of Mexico, by a strait one mile in width, the greatest depth of which is twenty-four feet. The banks of this entrance consist of sand drifts, which rise but a few feet above the surface of the water.

That on the west side, separated from the main land by a shallow lagoon, is called Foster's Island; that of the opposite side, likewise separated by a

\* Commander Johnston, U. S. N., and Dr. Holmes, U. S. A., MSS. *penes me*.

† Med. Statist. U. S. A., p. 296.



long, navigable sound, is called Santa Rosa Island. This island stretches off to the east for the distance of forty miles, being from one to two miles in width, and rising in some places to such a height, that its white sands are visible to a considerable distance, and serve as beacons to the navigator. Its surface presents many little pools and marshes, abounding in shrubs and rattlesnakes, and is generally studded with tufts of a heath-like undershrub (*Ceratiola cricoides*), among which there are a few scattering and stunted pines and live oaks. Its whole outer bench is lashed by the waves and swells of the Gulf. Its opposite shore is separated from the continent, by Santa Rosa Sound, just mentioned, which opens into the Bay of Pensacola, about three miles from its mouth. From below the junction of the Sound, the Bay widens; yet one shore is everywhere distinctly visible from the other. On both sides a post-tertiary or tertiary plain, from twenty to eighty feet high, composed of yellowish sand above, and white sand beneath, approaches more or less closely to the margin of the Bay, and constitutes its banks. At the distance of about twenty miles inland, the Bay, like that of Tampa, terminates in two heads or subordinate bays.

The eastern, called St. Mary de Galves, has two small tributaries bearing the names of Yellow Water, and Black Water Rivers. The western, named Escambia, receives the waters of the river Escambia. The two former of these rivers, drain but a small tract of sterile country, and therefore throw into their receptacle a correspondingly limited quantity of silt. Their estuaries, however, are flanked with impenetrable cypress swamps, as may be seen by a reference to *Pl. III.* The Escambia, originating in the state of Alabama, where the soil is fertile, has brought down, and deposited in its portion of the bay, an extensive bed of alluvion, which is sufficiently elevated to support such trees, shrubs, and gramineous plants, as delight in sub-aquatic situations. Among the last, is a tall culmiferous grass (*Phragmites communis*), having perennial roots, but annual stems, which, by their luxuriant growth, and speedy decay, constantly add to the vegetable elements of these deposits of silt. Near its mouth, this river, like the others, is bordered with broad cypress swamps, which are terminated by higher post-tertiary deposits, bearing long-leaved pines. In the first twenty miles from the Gulf, that is to the place of bifurcation, the axis of Pensacola Bay is nearly north-east; but the prongs, or subordinate bays, turn to the north. In various places the shores are skirted with narrow salt marshes, and, around the heads of the Bay, especially between its divisions, there are extensive cypress swamps.

Viewed from any position, Pensacola Bay is an object of much natural beauty. Its pellucid waters, salt enough to abound in oyster beds, are encircled at their very edge with a narrow girdle of white sand, which harmonizes pleasantly with the foliage of the live oaks, magnolias, cypresses, hollies, and various flowering shrubs, which overshadow its margins, and







relieve the somber back ground of long-leaved pine woods, which overshadow the higher terraces.

The medical, naval, and military histories of Pensacola Bay, are of equal interest with its scenery. The first merits great attention, from the national importance of the two latter. Constituting the only sheltered and capacious harbor on the northern semicircle of the Gulf, the Government has made this bay a naval station, and erected the various works necessary to its defense. At the entrance there are three fortifications: Fort Pickens, on the west end of Santa Rosa Island; Fort McGree, on the east end of Foster's island; and Fort Barrancas, a mile above, on more elevated ground. At the distance of another mile, on the same low sand ridge, stands the Naval Hospital; and a mile higher up the bay, on the same side, the Navy Yard. The road from one to the other of these establishments, passes over loose dunes of white and yellow sand, which, by the action of the winds, is continually drifted from place to place. These sands produce pines and other plants that flourish in such localities; but their recrements do not accumulate on the surface; for the soluble parts sink with the rain water into the loose strata beneath, and the insoluble are buried up by the action of the winds. Even the mold and manure, which are thrown upon the gardens attached to the Navy Yard, are speedily dissipated, and a surface, not unlike that of drifted snow, reappears. Still, in the midst of these dunes, there are concavities in which accumulations of soil, or matters impervious to water, have been made, and thus pools or swales, bearing sub-aquatic shrubs and herbaceous plants, have been generated. They are, however, of limited extent. Above the Navy Yard, as may be seen on *Pl. III.*, there are two bayous, bordered with salt marsh, and surrounded by dry and elevated pine terraces, presenting the site of the old Cantonment Olinch. Ten miles from the portals of the Bay, keeping still on its western side, stands the ancient—

II. *TOWN OF PENSACOLA*, in N. Lat.  $30^{\circ} 28'$  and W. Lon.  $87^{\circ} 12'$ . Its site is a level plain of blown sand, rising but a few feet above the surface of the water, and surrounded by the post-tertiary, pine-covered terrace, which every where environs the Bay. Between the town plat and this terrace, there is a narrow, semi-circular belt of swamp, originally covered with cypress trees, (*Cupressus disticha*), which have been replaced by a dense jungle of Titi bushes (*Mylocarum ligustrinum*). Numerous springs of soft water, the product of rain upon the adjacent plateau, discharge themselves into this swampy belt, the extremities of which are salt marshes, of limited extent. In the month of March, I found the heat of these springs as low as sixty-two degrees Fahrenheit; a temperature, which shows their origin to be superficial, and that they had been affected by the previous winter. By these springs the water of this paludal tract is kept pure; and by the compact Titi grove, the rays of the sun are prevented from acting on its surface.

Pensacola is an old town, and settlements near the outlet of the Bay were made before that of the town. Having belonged successively to Spain,

France, England, and the United States, its population, improvements, and modes of living, offer a mixture of the whole. The houses, mostly of wood, are chiefly built in the Spanish and French styles, and scatteringly distributed over the plain.

Apart from the people of the town, the seamen of our national ships, the persons attached to the Navy Yard, and the small garrisons which man the different forts, the population of Pensacola Bay is but limited; for the surrounding country is, in general, too sterile for profitable agriculture. The densest population, beyond the limits of the town, is found near the mouth of Blackwater River.

The yellow fever has been several times prevalent in the town, among the shipping, and at the Navy Yard; but the number and malignity of its invasions bear no comparison to its severe visitations of Mobile and New Orleans.

Of autumnal intermittent and remittent fever, it will be proper to speak more extensively. From the forts to the town of Pensacola inclusive, (all on the west side of the Bay), although there are some swales and small swamps or ponds among the sand dunes, and some narrow tracts of salt marsh, there are, as we have seen, no deposits of silt; and the organic matters accumulated in the wet or paludal spots, are chiefly those which belong to the pine forest. Now the inhabitants of this range of coast have for a long time enjoyed an exemption from autumnal fever, remarkable for a southern locality. The town of Pensacola has even been resorted to as a summer residence by citizens of Mobile and New Orleans. When, however, we ascend the same coast, about ten miles above the town, to the estuary of the Escambia River, we find a state of things entirely different. The silt brought down by that stream, has filled, as we have seen, a large portion of the western head of the Bay, and thus generated a marsh, several miles in width, near which the settlers have been fatally scourged by autumnal fever; although they escaped yellow fever when it prevailed in the town and Navy Yard below. The medical history of this devoted locality dates back more than eighty years, as may be seen from the following narrative by Lind. \*

"In the year 1766, sixteen French protestant families, consisting of sixty persons, were sent, at the expense of the English government, to West Florida. The ground allotted for their residence was on the side of a hill, surrounded with marshes, at the mouth of the river Escambia.† These new planters arrived in winter, and continued perfectly healthy until the sickly months, which in that country are those of July and August. About that time eight gentlemen (from one of whom I received this account) went to

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\* Essay on the Diseases Incidental to Europeans, in Hot Climates. By James Lind, M. D. Phil. Ed., 1811, p. 161.

† Escambia.

this new settlement to solicit votes for the election of a representative in the general assembly of the province; by remaining but one night, every one of them was seized with a violent intermitting fever, of which the candidate for becoming the representative, and another of their number, died. The next day seven other gentlemen came upon the same business to this unhealthy spot; but, by leaving it before night, they escaped the sickness, and all continued in perfect health. Among the French settlers, during these two months, the annual fever of the climate proved so fatal on this unwholesome spot, that of sixty persons fourteen only survived; and even those who remained alive, in the September and October following, were all in a very ill state of health; not one of them had escaped the attack of the fever, and most of them died within a few months afterward, from the injury it had done to their constitutions."

No other settlement in this locality seems to have been attempted for a long time afterward. At length, in the year 1832 or 1833, a new attempt was made, by laying off a town, to be called Florida on the eastern side of the estuary, in the edge of the pine woods; as may be seen by a reference to *Pl. III.* All the pine terraces of the south are proverbially free from autumnal fever; but here the pine lands lie to the leeward, while extensive silt marshes spread out to the windward. Between twenty and thirty wooden houses were built, and tenanted by as many families. Their history, as given me by Dr. Hulac, the intelligent and reliable surgeon of the Naval Hospital, and by Mr. Innerarity and Mr. Kolly, old and respectable citizens of Pensacola, may be told in a few words. Year after year, while the inhabitants of the coast below remained healthy, they were assailed by autumnal fevers of the most malignant character; the spot was at last called a "Graveyard;" and being abandoned by those who survived, I found, on passing through it in 1843, but two families remaining.

These well-ascertained facts have so important a bearing on the origin of autumnal fever, that I have considered them worthy of circumstantial detail. The heat and moisture of the lower and upper portions of this little Bay are the same; but while the former has only a few limited tracts of pine marsh, the latter includes extensive deposits of silt and organic matter; and to them, I think, we are bound to attribute the fatal insalubrity which has been described.

III. PERDIDO BAY is found a few miles west of that which has been described. Its coasts are composed of white sand, with copses of live oak. Its seclusion is very great; yet several naval officers have placed their families on its retired banks, near the Gulf, where they are said to spend the summer and autumn in perfect exemption from every form of fever. Such is the connection between a sandy surface, and a salubrious summer atmosphere.



## SECTION VIII.

## MOBILE BAY AND CITY.

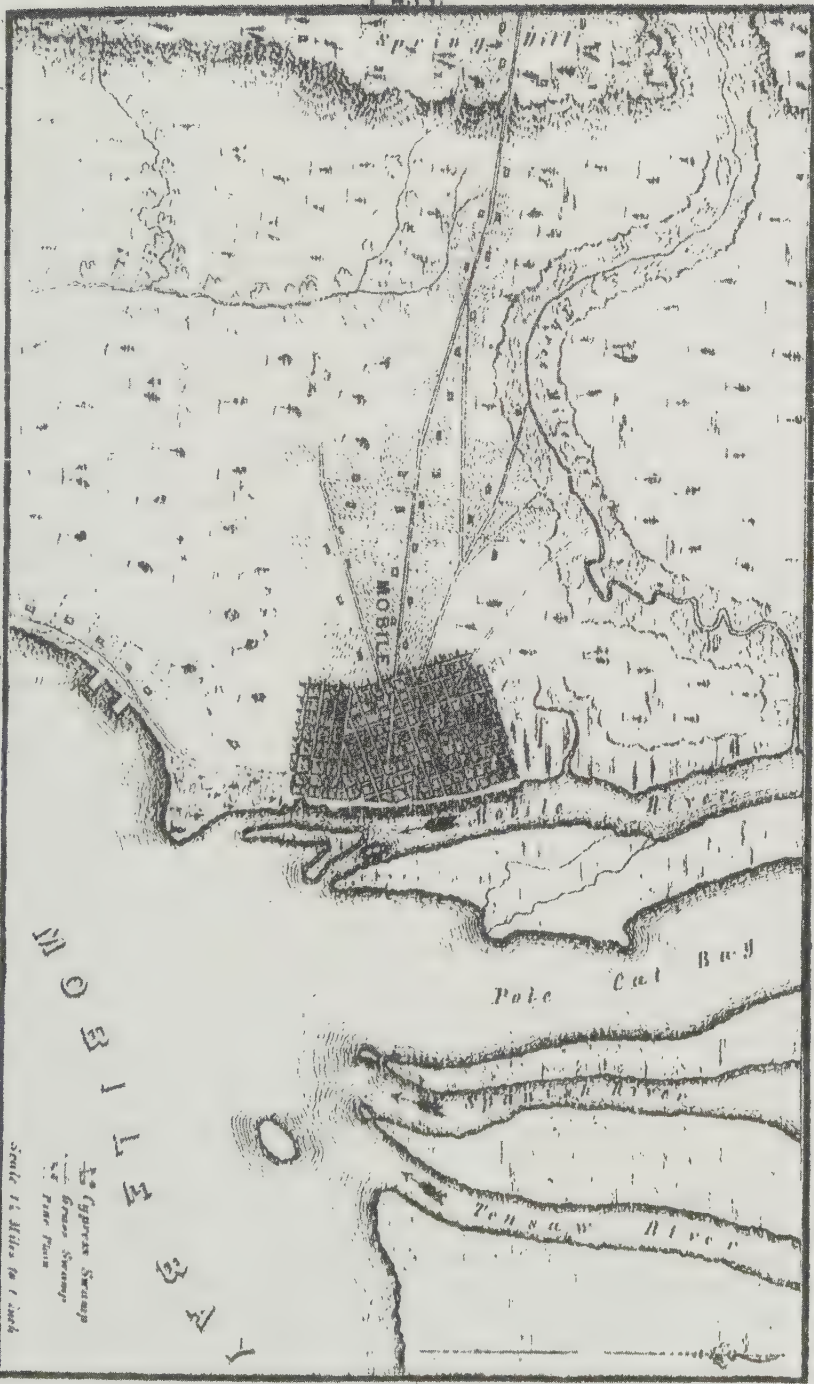
I. **MOBILE BAY** (*Pl. IV*) is one of the largest, and decidedly the most regular in form, of any with which the northern coast of the Gulf of Mexico is indented. Its axis lies in the meridian. Its broad base is more than half cut through by a low, narrow, peninsular sand dune, which penetrates it on the eastern side, and, approaching Dauphin Island (another dune of white sand), narrows the entrance to a strait; immediately within which is the harbor—the water of the Bay being too shallow to permit the further ingress of ordinary ships. Near the Gulf, this Bay presents a broad expansion, but soon becomes much narrower by an approximation of its eastern to its western coast;—the latter continuing, nearly in a straight line, into the interior. This narrowing reduces it to twelve or fifteen miles; which breadth it retains nearly to its head. The banks on either side, are composed of post tertiary or tertiary sand and clay, of which the predominant colors are yellow, white, and red. The Bay receives but a single river, which, by several mouths, enters at its apex, having previously assumed its name. The constituent streams of this river have been indicated when treating of our hydrographical axes. They drain a region of country, chiefly in Alabama, equal in area to that state, or more than fifty thousand square miles; and hence, more water is thrown into this Bay, than into any other around the Gulf. The Coosa and Tallapoosa, uniting, form the Alabama; and the Tuscaloosa and Tombecbee, joining, form a common trunk, which retains the name of the latter. As they flow on to the south, the Alabama and Tombecbee gradually approach, and at length, about one hundred miles from the Gulf, mingle their waters, lose their name, and are called Mobile River. Their place of junction was, no doubt, once the head of Mobile Bay.\* Thence to the head of the existing Bay, there is a series of low, alluvial islands, surrounded by river channels, known under the names Mobile, Tensaw, and Spanish River.

Two-thirds of the region which the river drains, is composed of loose or decomposable tertiary and cretaceous deposits, sufficiently fertile to support a luxuriant tree and herbaceous vegetation; and hence the supply of alluvion is inexhaustible. With these materials, organic and inorganic, the river has filled the upper part of the Bay; and is still carrying on a work, which has been already completed in the estuary of the Mississippi. When the drift-wood and sand meet the tides of the Bay, they are lodged against the shores, or deposited on the bottom; but the argillaceous matter advances further toward the Gulf, and gives to the lower part of the Bay a bottom of mud, which is gradually diminishing the depth of its waters. Thus, at some indefinitely future period, the Bay will be filled up; after which, the Mobile, like the Mississippi River, will begin to project a peninsula, or cape, into

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\* Dr. Heustis: Amer. Jour. Med. and Phys. Sci., Vol. XIX, p. 68.

Comp. 58.



MOBILE

Pole Cat Bay

Tensaw River

Legend:  
 Cypress Swamp  
 Grass Swamp  
 Pine Plain

Scale 10 Miles to 1 inch

C. I. Fuller & Co. Printers





the Gulf. In these progressive changes, Mobile Bay differs widely from Tampa Bay, while the Bay of Pensacola is intermediate, as to condition, not less than locality.

In a generalizing comparison of the Mississippi, Mobile, Pensacola, and Tampa estuaries, we find that the ratio of filling up, has been according to the order in which they have been named; which, again, corresponds to the relative magnitude of the rivers which enter them, and the fertility and progressive elevation above the sea, of the regions which they drain. The shores of Mobile Bay are skirted with silt marshes and cypress swamps, beyond which the banks are more elevated than those around Pensacola Bay, and covered with pine and oak forests. In some places, the banks press closely on the waters of the Bay.

II. MOBILE, the commercial metropolis of the state of Alabama, and also of south-eastern Mississippi, is built near the present head of the Bay, on its western side, thirty miles from the Gulf, in N. Lat.  $30^{\circ} 41' 48''$ , and W. Lon.  $87^{\circ} 50'$ . Its site is an ancient beach of the Bay, rising from the water's edge to the height of eight or ten feet, and extending back to the post tertiary, or tertiary plain, at the distance of six or seven miles. The margin next the Bay, was originally overflowed by tides and waves, and consisted of river alluvion, imbedding the trunks of trees. Much of the site, which is somewhat terraced, like the river bottoms of the interior of the Great Valley, is sandy, with beds of clay beneath, which prevent the rains from sinking into the earth, and lead to the formation of swales, or marshy grounds, that require ditching before they can be cultivated. A well, dug at some distance from the Bay, but on the city plat, passed through yellow sand for sixteen feet, affording good water; but on descending a few feet deeper, a fetid mud, enveloping the trunks of trees, was reached, and the water was spoiled.\* In another part of the city, a well was dug to the depth of twenty-five feet. It passed through strata of clay and sand, and then came to marsh mud, with the trunks and leaves of trees.†

To the south, adjoining the city, there is a cypress swamp, considerable portions of which are overflowed by the high tides of the Bay, or by the waves, when swells from the Gulf ascend it. The water of this swamp is chiefly supplied, however, by springs, which issue from the base of the neighboring sand terrace. The margin of the swamp rests on an immense deposit of silt and drift wood, which presents a foul and suspicious aspect. On the upper or north side of the city, and constituting to some degree its boundary, is a small bayou, called One Mile Creek; and beyond it another, named Three Mile Creek; designations which indicate their distances from the city. On each side of, and between these sluggish streams, there are swamps overshadowed with cypress, sweet-gum (*Liquidambar styraciflua*), magnolia, and other trees and shrubs, common in such localities of the South. These

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\* Dr. Gates.

† Dr. Houstis: Amer. Jour.

swamps never become dry, even to the depth of two inches below the surface.\*

In front of the city, the Bay abounds in islets and beds of alluvion, enveloping driftwood and covered with a heavy growth of reed grass (*Phragmites communis*), and other aquatic and sub-aquatic plants.

III. SPRING HILL, at the distance of six miles from the margin of the Bay, is the permanent residence of several families, and a place of retreat for the inhabitants of the city in seasons of yellow fever. This bluff is the eastern border of the pine terrace which surrounds the Bay, the waters of which, no doubt, once overspread the lower plain to this bluff. Its elevation is something more than one hundred feet. Several copious springs, which I found in the month of April to have the temperature of sixty-eight degrees, Fahrenheit, issue from this escarpment. One of them, by an under-ground hydraulic system, is made to supply the city; the water of the Bay being too brackish for domestic use. Derived from the rains which fall on the terrace behind, the water of this and other springs which I examined, appears to contain nothing but a trace of muriate of soda. As the citizens of Mobile, and especially its recent immigrants, look to this spot as a place of escape from danger, during the yellow fever months, I may be excused for adding, that a natural curiosity exists in the neighborhood, a visit to which may relieve the tedium of an anxious exile from the city.

IV. THE THUNDERING SPRING. About eight miles west south-west of Spring Hill, the road passing through a forest of long-leaved pine, is the fountain to which this name is applied. It boils up, in the edge of a valley two or three hundred yards wide, with such copiousness as to form a considerable brook. The water is transparent, but throws up a quantity of yellowish sand, which, in part deposited around, has formed a sort of crater. A pole can be thrust down about ten feet, when it strikes a rock; which, judging from quarries in the neighborhood, must be a soft, tertiary sand stone. The temperature of this spring, in the month of April, was sixty-nine degrees, Fahrenheit; its mineral impregnation, the same as that at Spring Hill. No gas of any kind escapes. The name which this fountain has received, was suggested by a remarkable peculiarity. A subterranean sound, like that of low, distant, and muttering thunder, is distinctly heard, at short but not regular or rhythmical intervals. On applying my ear to the trunk of a neighboring tree, this thundering, or earthquake-sound, was not only louder, but I heard a *constant* sound, resembling that produced by holding a finger in the ear; and which every now and then was augmented to the rumbling which has been described. Some very susceptible persons affirm, that they can, by their feet, feel a slight vibration of the ground. The radius of the sound is so limited, as to indicate that the peculiar movement of the waters, or some other agency which occasions it, is not far below the

\* Dr. Lewis: New Orleans Med. Jour., Vol. I, p. 282.

surface. Some efforts have been made to add this place to Spring Hill, as a summer resort; but the desire of those who retreat from the epidemics of the city, is, to remain so near as to receive early intelligence from those whom they have left behind, and, as yet, it has not been much frequented. About two hundred yards below this spring, on the same level, there is another which emits no sound. Its temperature is one degree less.

V. INHABITANTS.—A settlement was commenced on Mobile Bay, by the French, about the year 1700. In 1712, Homans published a map, which presents Port Louis, near or on the spot where the city now stands.\* From that time, until the cession of Louisiana to the United States, in 1803, Mobile was occupied either by the French or Spaniards. For many years after the cession, it attracted but little notice, and continued to be a rude and unimportant village; but about the year 1825, it began to fix the attention of the people of the northern states of the Union; and in twenty years became a city of eight or ten thousand inhabitants; consisting chiefly of Americans, the French and Spaniards having mostly left it. The new houses, nearly all of wood, are built in the fashion of other American towns, though many of the old habitations are interspersed among them. The streets are paved with semi-fossilized shells, chiefly the *Rangia cyrenoides*; which are found in long, low beds near the city, as also in various other places around the Gulf, at the elevation of a few feet above the highest tides.†

Next to New Orleans, Mobile has suffered more from yellow fever than any other town north of Havana and Tampico. As might be expected from its topography, faithfully represented in *Pl. IV*, autumnal fever, both intermittent and remittent, of every type and grade of violence, is an annual visitant; and frequently imposes on the yellow fever a certain degree of periodicity. It is not, of course, limited to the city; but appears, with even greater intensity, among the people of the surrounding alluvial plain, and on the foul margins of the Bay, both above and below the city. The inhabitants of the neighboring pine woods remain exempt.

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## SECTION IX.

### MINOR BAYS.

Between Mobile and New Orleans, there are three small Bays (*Pl. V*), which deserve the attention of the medical topographer; as they are places of refuge for the people of those cities during the prevalence of epidemics; and resorts for sea bathing, not only for those citizens, but the people of the interior. They are defended from the Gulf by a series of islands, which stretch

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\* Darby's Louisiana, p. 316.

† Conrad.



directly west from the mouth of Mobile Bay, under the names of Dauphin, Petit Bois, Round, Horn, Dog, Ship, and Cat; between which and the main land there is water of sufficient depth for small steamers.

I. PASCAGOULA BAY.—This is the most eastern. It receives, on its west side, the waters of Pascagoula River, which drains the ten or twelve south eastern counties of the state of Mississippi, and some of the adjoining parts of Alabama. Being an alluvial stream, it has made extensive deposits in its estuary, and reaches the Bay by two mouths, which are separated and skirted by low alluvial grounds and small lakes. On the opposite coast of the Bay, there are likewise marshes and lagoons. Between them, to the east, stands the old French village of Pascagoula, now Krebbsville; and near the junction of the river with the Bay, there are modern residences, with an extensive hotel, having places for sea bathing in front. These settlements are on higher and dryer banks, which, at their base, present a fillet of white sand, in beautiful contrast with the waters of the Bay.\*

The French settlement on this Bay, was among the first on the northern shores of the Gulf of Mexico, and dates back to the early part of the eighteenth century. As Doctor Fearn, of Mobile, has informed me, it is seldom visited by yellow fever; and being but little infested even with autumnal fevers, has become a place of summer retreat for the people of that city.

II. BAY OF BILOXI.—To the shores of the Bay of Biloxi belongs the distinction of having received the first immigrants to Louisiana. The settlement was begun by the French, in the month of May, 1690.†

I am indebted to the distinguished Dr. Samuel A. Cartwright, of Natchez, for an account of this locality, at which he spent several months. The Bay is in front of an arm or prong of Pascagoula Sound, with which it has a connection, as may be seen on *Pl. V.* about fifteen miles west of Pascagoula Bay. From its mouth, Biloxi Bay projects inland to the north-west, with an average width of two miles, until it attains the length of twelve or fourteen. The villas or settlements called Biloxi, are situated on the peninsula or tongue of land between Pascagoula Sound and this inlet, which, in their rear, is (locally) called Back Bay. This peninsula is about two miles wide and nine long. Its surface is sandy and sterile, with a narrow strip of lower and richer soil. There are no marshes, however, between the Sound and Back Bay; but on the farther or continental side of the Bay, there are fresh water swamps. Three streams or bayous enter the Bay on that side; all of which are deep and narrow. The Peninsula of Biloxi, is a place of sojourn for the people of New Orleans, during the prevalence of yellow fever,

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\* Besancon's Annual Register, p. 150.

† Bancroft's Hist. of the Col. of the U. S. Vol. III, p. 201.

but it has not always remained exempt from that epidemic. Autumnal fever, however, scarcely ever invades it.

III. BAY OF ST. LOUIS.—This beautiful little Bay lies west of Biloxi. I have not the materials for a description, but may state, in general terms, that the Pine Woods approach the Gulf shore to its east; and that it receives the waters of two small rivers, the Jourdain and the Wolf. Near the entrance of the Bay, on its eastern side, is Pass Christian, and on its western, Shieldsboro'; both of which are summer retreats for the people of Mobile and New Orleans, especially of the latter. This indicates, that it has been found a salubrious locality; yet, more than once, it has been invaded by yellow fever. Its liability to autumnal fever appears to be small.

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## SECTION X.

### THE PINE WOODS.

The medical topography of a country would be incomplete, if it did not comprehend specimens of its healthy localities along with the sickly; as it is by comparing them, that we arrive at a knowledge of the influence of topographical conditions, under the same climates. If the low and alluvial or marshy tracts, around this part of the Gulf, are infested with autumnal and yellow fevers, there is an adjacent plain, the height and composition of which, give it a decided character of salubrity. This tertiary or post-tertiary deposit of sea sand and clay, has been already referred to in the descriptions of Pensacola and Mobile. It borders the north-eastern segment of the Gulf, from Lake Pontchartrain, or rather from the delta of the Mississippi to Pensacola; and consequently lies in the rear of all the places which have been described. Between the city of Mobile and Pensacola, its altitude is one hundred and fifteen or twenty feet; but further back from the coast, it rises higher. The rivers which flow through it to the Gulf, are the Perdido, between Pensacola and Mobile, and the Pascagoula and Pearl, between the latter and Lake Pontchartrain; all of which are edged with swamps, overshadowed with cypress, sweet gum, and other semi-aquatic trees; decorated with a somber drapery of long moss (*Tillandsia usneoides*). The prevailing and characteristic forest tree of this plain, is the long-leaved pine; which, in many parts, as between Pensacola and Mobile, forms a dense and lofty forest, to the exclusion of almost every other tree. Straight, and generally destitute of limbs to a great height, these pines present to the eye a vast system of intercolumniation, which, soon at night, by the running fire that occasionally consumes their shed cones and long leaves, with the dry grass among which they have fallen, presents a grand and striking spectacle. This conflagration is one cause why so little humus, or mold, accumulates on the surface; another is that but little mold is generated by the *exuvie* of a pine forest, and hence the surface remains barren. Where the plain is too level for the water to flow off,

it has collected in small basins, and favored the growth of a more varied vegetation, the remains of which have contributed to arrest its descent into the earth; and thus, in the midst of the pine desert, the eye is relieved by oases of flowering shrubs and annual plants, from which rivulets are seen to flow and congregate into larger streams. In descending from the plain, they readily cut channels through its loose strata; from which there likewise issue copious springs of pure water, the quality of which has been already given, when speaking of the Pensacola and Mobile fountains.

Such are the celebrated *Pine Woods*, to the protecting influence of which the people of New Orleans and Mobile commit themselves for safety, in yellow fever seasons; expecting to enjoy an equal immunity from intermittents and remittents. Thus, in the region we are describing, the sweet gum and cypress, with their festoons of moss, are the symbols of deep soil, foul surface, impure water, vegetable decomposition, and fevers; while the long-leaved pine, symbolizes sterility, dryness of surface, gushing springs of pure water, and sound health.

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## CHAPTER IV.

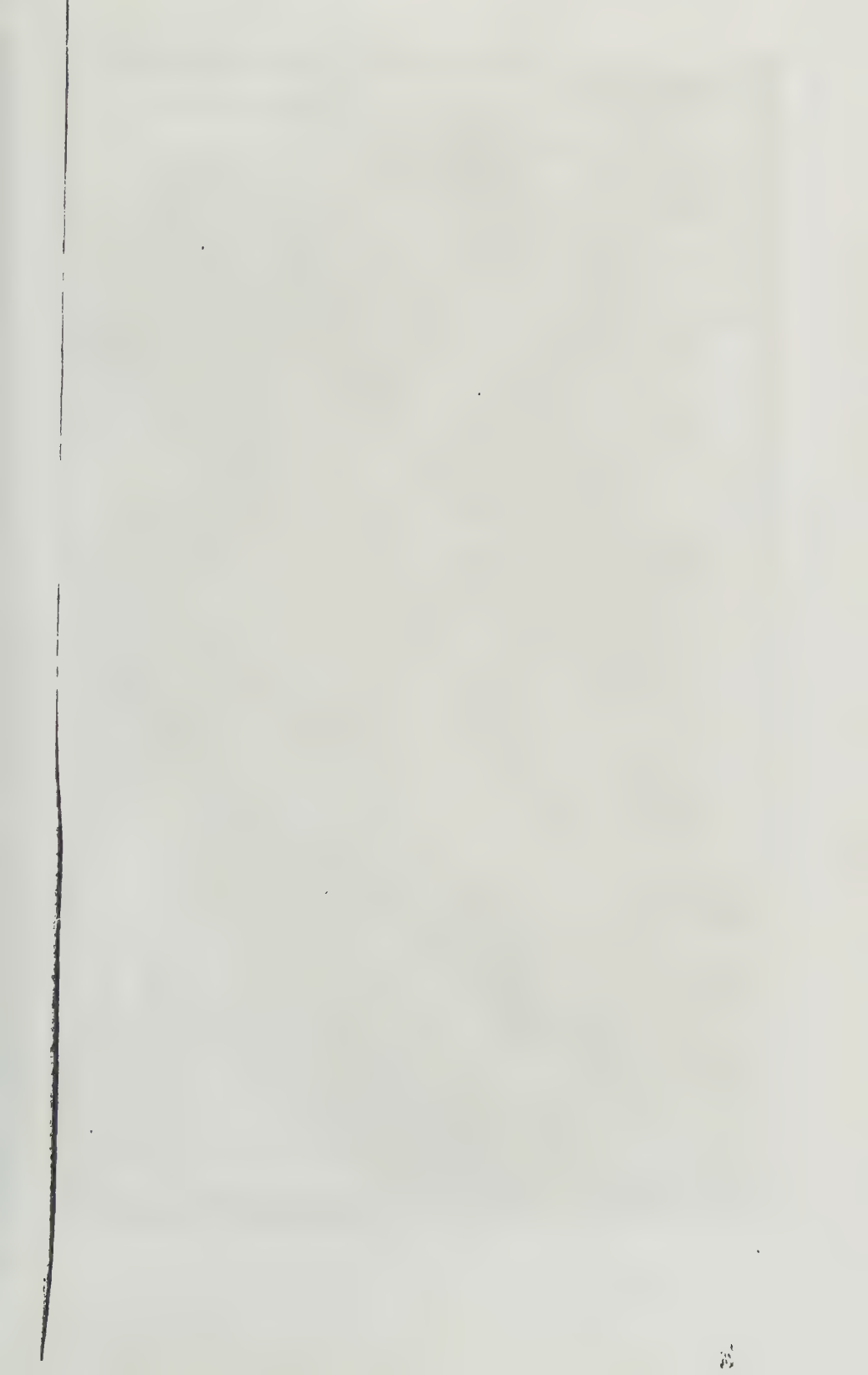
### THE SOUTHERN BASIN, CONTINUED.

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#### THE DELTA OF THE MISSISSIPPI—CONSIDERED AS A PART OF THE GULF COAST.

It is impossible to give an intelligible account of the Delta of the Mississippi, which must forever constitute the most important part of the coast of the Gulf of Mexico, without frequent references to the river above. This may sometimes carry us far into the interior; but such eccentricities are unavoidable, unless we had begun the analysis of the Southern Basin, with a description of the river itself, instead of the Gulf; which would, in the end, have involved us in greater difficulties. Our aim, in fact, is not to describe the Great Interior Valley, but to develop, before the reader, those physical conditions, which may be presumed to exercise an influence, either directly or indirectly, on health; and the same method is not adapted to both objects.







DELTA  
OF THE  
MISSISSIPPI

Scale of Miles



By J. Fisher

## SECTION I.

## DESCRIPTIVE HYDROGRAPHY.

The axis of the Delta of the Mississippi (*Pl. V*), lies nearly south-east and north west from the Balize, or junction of the North East Pass with the Gulf of Mexico, to the mouth of Red River; a distance, following the meanders of the stream, of three hundred and forty miles.\* In latitude, these extremities differ about two degrees—in longitude, nearly three. On the west, the Delta is bounded by the alluvial plains of Opelousas—on the east, by the tertiary, or post-tertiary highlands of West and East Feliciana, and of Baton Rouge; which, having closely approached the river, recede from it after passing that town, and trending to the east, pass round Lake Maurepas, Lake Pontchartrain, and Lake Borgne, to the Gulf of Mexico, at the Bay of St. Louis; thus including those lakes within the Delta. That they *do*, in fact, belong to it, is rendered certain, by the discharge of a portion of the waters of the Mississippi through the Iberville—a bayou which leaves the river a few miles below Baton Rouge, and joining the River Amite, after its descent from the plateau just mentioned, flows into Lake Maurepas; and thence, by the Bayou Manchac, into Pontchartrain, which is connected with Lake Borgne and the Gulf, by channels that meander among the Rigolets at the mouth of Pearl River. The water of these lakes, or, more properly, bays, is shallow and brackish; and they can be regarded in no other light, than as portions of the Gulf, partly filled up with silt, carried into them from the Mississippi by the Iberville, Amite, and Pearl Rivers. Within the historic period, the Iberville has conveyed but a moderate quantity of water; and of course the deposits from that source have latterly been small. Whether it did not formerly discharge a more copious stream, cannot be known. For the distance of one hundred and forty miles, the Mississippi, before a levee was constructed, poured over its left bank, during its annual swells, a great quantity of water, which finally made its way into the lakes just mentioned, and by its deposits must have contributed to their filling up. The prevention of this overflow by art, has thus diminished to some extent the ratio of deposition in the lakes, and prolonged indefinitely the process of their transformation into dry land. At present, the tract between them and the river, varying in width from five to twenty-four miles, is a cypress swamp, with ponds which are nearly on a level with the lakes. Much of it, however, in autumn, becomes dry land; and most of it is sufficiently elevated to admit of being reclaimed by adequate ditching and draining. South of Lake Borgne, down to Chandour Bay, there is, however, an extensive tract, (extending from the left bank of the Mississippi), which is permanently terraqueous, and mostly irrecclaimable.

That portion of the Delta which lies south-west of the Mississippi, is larger,

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\* Nicollot: Hydrograph. Basin.



and its hydrography much more intricate. Its *general* surface is everywhere below that of the waters which flow through, or rest upon it, when their great fountain, the Mississippi, is swollen. Hence most of it is uninhabited; and presents an indescribable labyrinth of lakes, ponds, bayous, swamps, and shaking prairies; much of which, however, by early autumn, becomes so dry as even to oppose an obstacle to its cultivation. The waters which replenish this system of natural canals and reservoirs, are derived from two sources: *first*, the streams which descend from the plateau of Opelousas on the west, and the bottom lands of Red River on the north; *second*, the bayous, or lateral outlets of the Mississippi, which are three in number. The largest and uppermost, is the Atchafalaya, which leaves the Mississippi only three miles below the mouth of Red River, and, in the opinion of Mr. Darby,\* was once the bed of the latter river. The descent of this bayou, at first, is rapid, and its course nearly south; while that of the Mississippi, after the separation, is south-east; and hence they diverge from each other. One hundred and twenty miles below, the main river sends out Bayou Plaquemine, which runs nearly west, until it joins a branch of the Atchafalaya. Thus reinforced, that bayou, when its parent stream is swollen, assumes the aspect of a large river. As it winds its way to the south-south-east, on a plain which declines gently to the south-south-west, it discharges a great quantity of water over its right bank, and sends off lateral bayous, which connect it with the Teche, with Lake Ochetimaches, or Grand Lake, and with several smaller lakes; while it pours a deep inundation over many extensive swamps. Before reaching the Gulf, at the distance (following its meanders) of nearly two hundred miles, it enters the lower end of Lake Ochetimaches, on issuing from which, it receives the Bayou Techo; whence both, in a single channel, flow on to Berwick's Bay, an arm of the Bay of Atchafalaya. There is, as yet, but little cultivation on the banks of the Atchafalaya and still less on those of the lake with which it is so intimately connected; for the entire area around that large reservoir, is subject to deep annual inundation. When the Mississippi is low, the current in the Atchafalaya and Techo is very slack, and the tides flow up them to a great distance.

The position of the Techo is west of the Atchafalaya, and its general course nearly parallel to that bayou. It skirts the plains of Opelousas, and traverses the parish of Attakapas, having lateral connections in its upper part, with the Atchafalaya, of which the principal is the Bayou Courtableau, through which, however, it does not, at present, receive much water.

In the opinion of Mr. Darby, a part of Red River once flowed in the Techo—a theory which may explain why its waters no longer rise to the level of its banks. This beautiful natural canal forms the south-western water boundary of the Delta.

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\* Geographical Description of the State of Louisiana, 1817.

Let us return to the Mississippi. At Donaldsonville, twenty-four miles below Bayou Plaquemine, and eighty above New Orleans, is the efflux of Bayou La Fourche, the last of any considerable size, sent off by the great river. The course of this bayou is at first south, and then south-west, to the Gulf, between Barataria and the Timballor Bays. Its length, sinuosities, and complications, are much less than those of the Atchafalaya. The entire tract between these two bayous is subject to deep, yearly submersion. That between the La Fourche and the Mississippi, in the direction of New Orleans, abounds in streams which originate within the delta, and in ponds and lakes, of which the largest is Barataria.

From this rapid hydrographical sketch, it will be seen that the Delta, west and south of the Mississippi, is a true terraqueous region, the greater portion of which is annually inundated; while in the neighborhood of the Gulf, there are large tracts of permanent salt marsh. The perfect silence and deep solitude of many parts of this peculiar region, are described by Mr. Darby as profoundly impressive. \*

The remaining hydrographical description need not detain us long. We begin with the Mississippi, at the head of the Delta, and follow it to the Gulf. On both sides, an artificial levee, or earth embankment, raises the banks of the river three or four feet above their original height, (which was previously greater than that of the swamps behind), and thus prevents the escape of any considerable quantity of water, except when a crevice is accidentally formed. On the outside of this embankment, lies the cleared and cultivated land, which may average a mile in width, and declines gradually to the cypress swamps in the rear. The depth of water in these swamps, varies from a few inches, to ponds and lagoons of several feet. In the spring and early summer, they are all flush; but before the following winter, extensive tracts of swamp have become dry land, to be again inundated.

Some plantations are so level, that the rains, and the water which percolates the banks or escapes by small crevices in the levee, when the river is swollen, will not flow off to the swamps. Ditches, intersecting each other at right angles, are then required, to receive and conduct it to the levee, through which it is discharged into the Mississippi, by steam power. The machinery for this purpose, is modeled after the paddle-wheels of our steam boats. Being placed in the ditch where it passes through the levee, the rotation of the wheel drives the water forward; this creates a depression, into which that behind, of course, immediately flows; and thus a current is established through the principal ditch, by which all connected with it are emptied.

As the voyager traverses the Delta, he finds a monotonous sameness in the natural scenery, which, however, contrasts agreeably with that of the interior

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\* In the foregoing sketch I have preferred to follow our distinguished Physical Geographer, Mr. Darby, rather than any more recent authority; on account of his well-known accuracy, and his having written from personal observation.

of the Valley. There he looks *up* to behold it—here he looks *down*; there he sees streams running *into* the river—here he sees them flowing *out*; there his horizon is *limited*—here it is *boundless*; there *diversity* of objects enables him to estimate his progress—here *uniformity* gives him the feeling of moving in an eddy. An equal sameness prevails in the subjects of cultivation on the banks; so that almost the only source of variety, is in the style of the old French and new American plantations, as they appear in succession.

Passing by New Orleans, which is one hundred and four miles from the junction of the Mississippi with the Gulf, the voyager, at the distance of fifty or sixty miles below the city, finds himself on a kind of peninsular cape, which projects boldly but obliquely into the Gulf; with Chandeleur Bay on his left, and Bastian Bay on his right. The banks have become much lower, and the belts of arable land narrower; at length, through some natural or artificial opening, he catches a momentary glance of the green waters of the Gulf. Further on, the banks sink nearly to the level of the salt water, and the swamps, with a diminished number of trees, begin to crowd hard upon the river; which, after having given off numerous small bayous, divides, about twenty miles from its termination in the Gulf, into three channels, and thus presents a subordinate and more limited delta. These channels are called the *South West Pass*, the *South Pass*, and the *North East Pass*; the last of which, at the distance of seven or eight miles from the Gulf, sends off, northerly, the *Pass a la Loure*; and in the opposite direction, the little *Bayou*, on which stands that old pilot's emporium, the *Balize*; finally, the main trunk divides, before reaching the Gulf, and while one branch retains the name of *North East*, the other is called the *South East Pass*. The interest which attaches to this extreme point of the Delta, requires that a Section should be specifically appropriated to it.

## SECTION II.

### RISE AND FALL OF THE LOWER MISSISSIPPI.

In conformity to the general law, that as we descend great rivers to the sea, the range between high and low water diminishes, we find that of the Mississippi much greater above than within its Delta.

The following TABLE shows this range at several points from Natchez to the Gulf:

Localities.	Distance from the Gulf.	Range from low to high water.
Natchez,	406 Miles.	52 Feet. *
Baton Rouge,	244 "	30 "
Donaldsonville,	187 "	25 " †
New Orleans,	104 "	14 "
Balize,	2 "	3 "
Cincinnati, on the Ohio River,	1548 "	63 "

\* Nicollet.—Too much, I suspect. † Darby.



Not having data for the Mississippi above Natchez, I have added the range from low to high water at Cincinnati, on the Ohio river.

At first view, it might be supposed, that the longer the range between high and low water, the greater is the overflow of the banks; but the reverse is the fact; for the inundations become deeper, and of more frequent occurrence as we descend; and but for the levees, the whole Delta would be deeply submerged every spring and summer.

While the rivers, which, by their union, make up the Mississippi, rise and fall several times in the course of every year, that river, within the Delta, has generally but one rise and one fall; that is, a maximum which it slowly attains, and a minimum to which it sinks as gradually. This will appear from the following TABLE:\*

MONTHLY REGRESSION OF THE MISSISSIPPI FROM HIGH WATER MARK AT NEW ORLEANS: AVERAGE OF THE CALENDAR YEARS, 1833, 1834, 1835, AND 1836.

January,	7.00 Feet.	July,	6.82 Feet.
February,	5.13 "	August,	7.97 "
March,	4.27 "	September,	13.10 "
April,	2.94 "	October,	13.33 "
May,	4.67 "	November,	12.34 "
June,	4.79 "	December,	8.84 "

We are here presented with a gradual fall from April to October, and as gradual a rise through the remaining five months.

The greatest flood cannot often occur as early as March, as the rivers of the north have not then broken up; and it does not always happen in April. Thus, in 1843, I found the maximum in June; and in 1844, in July. In these instances, however, extraordinary rains had reinforced the usual spring floods.

The sustained elevation from February to July, results from the progressive opening of spring, beginning in the low latitudes of Red River, the Arkansas, and the Tennessee, and extending, with the advance of spring, to the sources of the Mississippi proper, and the Missouri, in latitudes forty-seven and forty-eight degrees. If the Mississippi flowed to the east or west, its vernal rise would be more rapid, more elevated, and of shorter duration. After the subsidence commences, less and less water, of course, flows into its bayous, or oozes through its banks; and, as that which has been effused drains off into the Gulf, large tracts, as already mentioned, are laid bare, and at length, under the burning sun of July, August, and September, are dried until they crack open;—thus passing, in the course of two months, from a saturated condition to the opposite extreme.

\* Barton, in *Historical Notice of New Orleans*, p. 290, 1840.

## SECTION III.

## DEPTH OF THE LOWER MISSISSIPPI.

In advancing from the interior to the Gulf, the volume of the river increases far more in a vertical, than in a horizontal direction. Indeed, its width above the mouth of the Missouri, is often quite as great as below the mouth of Red River, the last of its tributaries. Within the Delta, its depth becomes so great, that bars and islands are nearly unknown; and snags are almost as rare, except along its banks. Accurate soundings have not, however, been made at many points. According to Mr. Darby,\* an admeasurement taken nine miles below the efflux of Bayou La Fourche, and one hundred and seventy-five from the river's mouth, gave a depth of one hundred and fifty feet beneath high water mark. At New Orleans, Mr. Albert Stein, Civil Engineer,† and Professor Riddell, of the Medical College of Louisiana,‡ have made soundings, which gave, respectively, one hundred and fifty, and one hundred and forty-two feet; but in 1844, several gentlemen and myself sounded opposite the city, and unexpectedly found a depth of two hundred and forty feet. There might have been some error in the experiment; nevertheless, I was informed by Captain Whiting, U. S. A., that certain officers of the army, in sounding opposite the Barracks, three miles below the city, found a pool of still greater depth. Of the soundings from this point to the division into three Passes, twenty miles from the Gulf, I cannot speak. In the South West Pass, Mr. Stein found the average depth sixty-eight feet; the greatest, eighty; the least, fifty-four. Near the outlet or bar, it was twenty-two; on the bar, as low as fifteen, and even thirteen feet four inches. The South Pass is much shallower; and the North East Pass is also not so deep as the South West.

Assuming one of the lowest soundings opposite the city—one hundred and fifty feet—as the basis of a calculation, and deducting therefrom ten feet for the fall of the river from the city to the Gulf, and fifteen feet for the depth of water at the South West Pass, we find that the bottom, at that Pass, is one hundred and twenty-five feet higher than the bottom opposite the city; and that, consequently, the water at the bottom in front of the city must ascend that height before it can surmount the bars and reach the Gulf, or else it constitutes an eddying pool.

The fall of the surface of the Mississippi, at low water, through that part of the Delta which extends from its vertex at Red River to New Orleans, is sixty-five feet; which, divided by the distance—two hundred and thirty-six miles—is equal to three inches and three-tenths per mile. Below the city to the Gulf, the fall is one inch and two-tenths. Thus, the farther the Delta

\* Description of La., p. 65.

† Documents on the Navigation of the Mississippi River, p. 47

‡ Commercial Review of the South West. Vol. II, p. 437.

advances into the Gulf, the greater is its horizontality, and, consequently, the slower its current. From experiments made at New Orleans, Professor Riddell and Mr. Stein have been led to fix on two feet per second as an average velocity for all stages of water.

## SECTION IV.

### TEMPERATURE OF THE RIVER.

Several circumstances influence the temperature of rivers: *First*. A stream largely supplied from springs, will be warmer in winter and cooler in summer, than its banks beneath the surface, or the air resting upon it. *Second*. A shallow river is much sooner brought to the temperature of the earth's surface, and that of the air, than a deeper one. *Third*. An alluvial and turbid river will, *ceteris paribus*, be more heated by the sun than one which is transparent; as it is by impinging on solid and opaque bodies, that the sun's rays develop caloric; while, at the same time, its bed will radiate less heat than if its waters were clear. *Fourth*. When a river descends rapidly upon a plain, its waters will be cooler than those of another river of the same volume originating on the plain. *Fifth*. When one river flows nearly under a parallel of latitude, and another in the meridian, the former will have the temperature proper to the latitude, while the latter, if it flows from the north, will be colder, having that which is the mean of all the latitudes it has passed through. Thus, as I have several times observed, the Ohio, which flows nearly west, is two degrees warmer than the Mississippi, which descends from the north, both being examined near their junction. To the west of the Mississippi, the Arkansas, the Kansas, and the Platte, like the Ohio, flow nearly under the parallels in which they originate; but the Missouri and Upper Mississippi originate in high latitudes, and descend to the south. In reference to the Delta, the whole are northern. If we assume two miles an hour for the average velocity of the river, as it traverses the Delta three hundred and forty miles, that portion of the river bed empties itself, and is filled with cooler water from the north, every seven days. To enable us to estimate the effect of this circulation on the climate of the Delta, we must ascertain both the area of the river's surface, and its actual temperature. The former may be obtained without much uncertainty. Taking its length, from the mouth of Red River to the Balize at three hundred and forty miles, and its breadth at half a mile, we have one hundred and seventy square miles as its area; but to this we may safely add thirty, for the area of the greater bayous, giving two hundred square miles of river surface within the Delta. The latter desideratum—the annual temperature of this water—presents a greater difficulty. It has not, indeed, been ascertained; at least, I have not met with the requisite observations. On the 24th of February, 1843, I found the temperature of the water flowing into the Gulf over the



bar of the South West, or deepest Pass, to be forty-two and a half degrees; while that of the Gulf, a few miles out, was fifty-six and a half, or fourteen degrees higher. On the 1st of March, the temperature in the middle of the North East Pass, opposite the Balize, was likewise forty-two and a half degrees; and on the 5th, that at Fort Jackson, thirty miles above, was the same. On the 11th of the same month, the temperature of Lake Pontchartrain was fifty-six, and of Lake Borgne fifty-five—average fifty-five and a half, or thirteen degrees higher. The difference of a degree between these lakes and the Gulf, doubtless arose from their higher latitudes. These were probably minimum winter temperatures; and they indicate, as a general average, a difference of thirteen and a half degrees between the waters arriving from the north, and those sojourning in the Gulf, on which the base of the Delta rests. I did not, however, find an equal difference in summer. On the 5th of June, of the same year, the temperature of Lake Pontchartrain was seventy-eight; that of the Mississippi within the Delta, on the 7th, was seventy-two—difference six degrees. This date was too early by almost two months, to give the highest summer heat. On the corresponding day of 1846, Professor Riddell \* found the heat to be seventy-five, or three degrees greater. His observations, continued, at short intervals, from the 21st of May to the 12th of August, show a gradual rise from seventy-two degrees at the first date, to eighty-five on the 1st of August; after which the temperature declined. The mean of his observations from the 12th of July to the 12th of August—eighty-three degrees—may, perhaps, be received as the *maximum* summer temperature of the river, in that year, at New Orleans. Opposite the same city, in February, 1848, the *minimum* was forty-one degrees. The mean of these numbers, sixty-two degrees, may, in the absence of better data, be received as the annual temperature of the river as it passes by the city, and it is several degrees below the atmospheric mean. Thus, observation confirms the *a priori* conclusion, that the Mississippi acts as a cooler to the banks and the atmosphere of its Delta; and when we recollect that it meanders through that region, until its surface amounts to two hundred square miles, that its trough is replenished every seven days, and that nearly all population and all cultivation are on its immediate banks, from which the water is abstracting caloric and transporting it to the Gulf, we seem called upon to believe, that its climatic influence ought not to be overlooked. This, however, is far from being equal throughout the year; for, as it depends on the quantity of water, it is, of course, least in the latter part of summer and in early autumn, when the river is low; and we find, in fact, that its temperature then rises to the mean heat of the atmosphere. Thus the extremes of winter and summer, are greater in the river than in the atmosphere of the Delta; and the difference results from depression of

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\* Com. Rev. of the South West, Vol. II, p. 436.

the former in winter and spring, or rather for the first half of the calendar year.

But it is not by its temperature only, that the Mississippi acts upon the climate of its Delta. During its annual flood, which continues from March to July, there is a constant infiltration into the banks, and an inundation, as we have seen, of large portions of the Delta. As this water has a temperature below the mean heat of the ground which it penetrates, or the surface which it overflows, some degree of refrigerating effect may be attributed to it; but a greater effect results from the evaporation in June, July, August, and September, which, of necessity, prevents the sun from heating the surface of the ground to as high a temperature as it would otherwise attain. This evaporation, moreover, maintains the humidity and freshness of the air. In conclusion, it may be said that, while the river floods, in March and April, lend their influence to the production of occasional cooler days and rawer winds, than would otherwise occur, they assist, in May and June, in giving to the banks a climate whose deliciousness is equalled only by its salubrity.

It would be interesting to know the mean annual temperature of the river at the different parallels which it traverses, for the purpose of comparing it with the mean atmospheric temperature; but observations to this end have not yet been made. I will, however, state a few which go to show the difference between two distant points, at nearly the same time, in two seasons of the year. On the 7th of June, 1843, the river being very high, its temperature near Bayou Sarr, within the Delta, was seventy-three degrees, and on the 10th, near Cairo, about nine hundred miles above, it was seventy; showing that it had only acquired one degree of heat, for every three hundred miles. On the 10th of February of the same year, when the river was not so high, I had found it, at the upper of these stations, thirty-four degrees, and at the lower, forty-two, indicating an increment of heat nearly three times as great as in the month of June. The difference in latitude between the stations is a little more than six degrees. So that, in summer, a flow through two degrees of latitude was necessary to the acquisition of one degree of temperature; but in winter, a degree of latitude gave one degree thirty-three hundredths of heat. It deserves to be added, that in the latter experiment, the temperature continued substantially the same to the Balize; though both the distance by the river and the difference in latitude were sufficient, if the ratio of increase had continued the same, to have raised it nearly two degrees. The small change of level may have been one cause of this constancy; but the facts are too few to warrant a generalization, or to develop the ratio of increased temperature, from diminished latitude and reduced elevation above the level of the Gulf.

## SECTION V.

## SUSPENDED AND DISSOLVED MATERIALS OF THE RIVER.

I. It will aid us in studying the medical geology of the Delta, to pass in review the materials which the river draws to itself from the countries which it drains; for all its deposits, however modified or mingled, are thence obtained and transmitted to its estuary.

1. As may be said of every other river, the waters which constitute the Mississippi are derived from the atmosphere, and reach its trough directly by flowing on the surface, or indirectly from under the surface, through which they have descended to burst out in the form of springs. We shall hereafter see, that the rains which fall within the basin of the Mississippi, are chiefly derived from the Gulf of Mexico; and thus the river is but the return to that reservoir of what had been given out. That portion of its water which flows from the surface, is not from rains alone, for nearly all the subordinate rivers, which unite in forming the main trunk, originate in latitudes or at elevations above the sea, in which deep snows annually fall; and hence the spring floods are composed largely of snow water.

Within the basin of the Mississippi, we have, as was shown in *Chapter I*, almost every kind of geological formation; and thus our springs and smaller streams throw into the river all the saline ingredients which water, as it flows among, or cuts through, various strata, is capable of dissolving. Of the whole, bicarbonate of lime and muriate of soda are undoubtedly the most abundant; but the former, from mere exposure and agitation, is in part decomposed and deposited before it reaches the Delta. The latter, however, continues in solution, and even increases in quantity, as the current advances; as Red River and the Arkansas, especially the former, afford, when low, a water so impregnated with salt as sometimes to impart a brackish taste.\*

2. The suspension of inorganic matter is immensely beyond its solution; and this again, from the variety of our mineral strata, may be as diversified as that of any other river. In centuries indefinitely past (the diluvial period), when mighty torrents traversed the continent from north to south, they no doubt rolled before them a great amount of solid matter in fragments too large to be suspended; and strata of pebble stones and gravel, in all probability, lie deeply buried up in the Delta; but at present, solid mineral matters are transported to it by suspension only. These are chiefly alumina or clay, and silicious and calcareous sand, very finely comminuted. Of these, and other suspended mineral matters, it is only the most finely powdered that reach the Delta, the coarser being deposited by the way; and hence, in descending the river from any point above, we observe a regular decrease of the larger *débris* of rocks, and a corresponding, proportional in-

\* Darby's View of the United States, p. 317.



crease of the smaller;—the highest degree of comminution being soon in those portions of the Delta which project farthest into the Gulf. Of the clays thus carried down, some are blue, others yellow, and others red. The last is chiefly from the river which bears that name. Those furnished by the Ohio, are always of some shade of yellow; those from the Missouri, are bluish.

3. The vegetable kingdom contributes largely to the mass of transported materials.

a. The forests on every tributary send down trees, and the Mississippi is perpetually uprooting the groves of cotton wood, and other trees; for the growth of which, it had not only deposited the soil, but sown the seed. In its progress, this driftwood becomes gradually stripped of its bark and branches, and all its soluble parts dissolve in the water. Much of it is deposited by the way, and much is towed to the shore after it reaches the Delta; yet not a little is deposited in the salt marshes of the Balize, or floated off on the surface of the Gulf.

b. The autumnal contribution of forest leaves and luxuriant annual plants, is very great; and from their levity, many of them reach the Delta; having in their progress given out to the water all their soluble elements.

c. The drainings of swamps and marshes, holding in solution whatever the water has found to dissolve, must not be overlooked.

4. The animal kingdom throws in a liberal contribution. Every tributary deep enough to float a carcass, is from time to time required to bear it off; and many animals of various sizes, which have perished on their banks, are uplifted by their floods, and borne away to the common trough. Still further, most of the trees and plants, whether green or in decay, which find their way into the river, take with them the worms and insects in which they abound.

5. All our cities and larger towns are on the Mississippi and its great tributaries. Their population cannot fall far short of a million; and the ordinary dependence of the whole is on their rivers, to receive the contents of the private and public sewers, and the drains from all establishments of industry. Thus a civic contribution—organic and inorganic, soluble and insoluble—is perpetually going forward.

6. The recrements from more than four hundred steamers, and twice or thrice as many flat boats, make an element of impurity not to be passed unnoticed; nor should we overlook the discharge into the river of the ashes, abounding in saline ingredients, which are produced by the daily combustion of many thousand cords of wood.

7. Finally: The water of the Mississippi abounds in *microscopic infusoria*. This was first announced, I think, by Professor Bailey, of the United States Military Academy, in February, 1845.\* In a specimen of water

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\* Proceedings of the Boston Society of Natural History.

taken from the river opposite St. Louis, he detected no less than twenty species, all living and active, a part of them soft, and a part with hard, silicious shells. Most of the species were in great numbers.

II. Such are the elements, organic and inorganic, living and dead, with which the Mississippi becomes freighted in its transit down the Interior Valley. The catalogue is rather startling; but before we decide against the purity of its waters, we must recollect a few facts. *First.* Their immense volume. *Second.* The subsidence in their eddies of a great deal of matter, which cannot, from its weight, be borne up without a rapid current. *Third.* The disintegrating and decomposing power of water, and the readiness with which gases, the product of decomposition, escape from running streams. *Fourth.* The fact, that when the river is low, and the heat of the latter part of summer in the south is great, the proportion of foreign ingredients is much less, than during the floods of spring and summer.

In a series of experiments, by Professor Riddell, continued from the 25th of May, when the river was within two feet of its greatest altitude at New Orleans, until the 10th of August, when it was but eighteen inches above low water mark, the proportion of suspended matter gradually lessened to one-third. At the beginning, the heat of the river was seventy-three degrees — at the end, eighty-three degrees. Thus, the *maximum* of both atmospheric and river heat in the Delta, coincides with the *minimum* of river impurity. If this fact have no bearing on the question of salubrity, when the water is used as a beverage, its connection with the production of gases is obvious, and well fitted to show, that in the season when fevers — ascribed to the presence of gases — are prevalent in the Delta, the material supplied by the river for their development, is greatly reduced, by diminution in both the volume of water, and the proportion of foreign ingredients.

III. The salubrity of the Mississippi water, or that of the Missouri, which imparts the character of turbidness, is not an open question. From St. Louis to New Orleans, the testimony of the population on its banks, and of those who spend a great part of their lives upon it as watermen, is unequivocally in its favor. Many persons drink it before its suspended materials have subsided, and seem to prefer it to that which has been rendered transparent by time or art. That it produces some effects on the system, which transparent water, from wells and springs, and our other rivers, does not, is an established popular opinion. It is even regarded by many persons as being, to a certain extent, medicinal, and especially adapted to the cure of chronic functional disorders of the stomach, bowels, and liver — an opinion in which I am disposed to concur. That its daily use averts some forms of disease, may be admitted as probable; but precise observations on all these points are wanting; and I shall dismiss the subject with the presentation of two facts, in which, I trust, the reader will take a pleasant interest. *First:* Professor Bailly, after observing its numerous shoals of microscopic animalcules, expresses the opinion, that they are

sufficiently abundant to render the water somewhat *nutritious*. *Second*: In his Letters on Louisiana, written in the year 1761, Captain Boissau informs us, that the Mississippi water has the property of contributing to the "*fécondité des femmes*!"

## SECTION VI.

### GEOLOGICAL AGE, DEPTH, GROWTH, STRUCTURE, AND CHEMICAL COMPOSITION OF THE DELTA.

The Delta, from its bottom up, is, of course, a newer formation than the marine deposits which are seen along its northern border above Baton Rouge; such deposits having been formed before the Mississippi existed, or the continent was raised from the sea. But of the *actual* age of the Delta, on the scale of ordinary chronology, nothing is known. Before the banks of the river were surmounted with levees, every year spread new deposits over their surface, and over the Delta generally; and had the ratio of annual growth been then noted, and could the depth of the reservoir thus filled up be ascertained, the problem of *time* might be solved. In the absence of such data, recourse has been had to the quantity of silt annually brought down by the river, and an assumed depth of the basin filled up; relying for the latter, on soundings in the Gulf beyond the line of river deposits. But to give even approximative exactness to this method, the river above the Bayou Atchafalaya should be gauged at every stage of water, and the velocity of the current determined for every elevation; this being done, and the proportions of silt correspondingly ascertained, an important part of the data for a computation would be obtained. The depth of the bay which has been filled would, however, still remain a desideratum; and the question, whether, in the period which immediately succeeded the elevation of the continent, the ratio of filling up was not much higher than at the present time, would require to be answered. When the great currents, to which reference has been repeatedly made, swept over the Interior Valley from north to south, the filling up of the long arm of the Gulf, which penetrated the continent as it is now penetrated by a similar arm from the Gulf of St. Lawrence, doubtless went on with great rapidity. To this end, the loose tertiary and cretaceous deposits on both sides of the ancient estuary, no doubt contributed a full share.

Happily the question of the rate at which the Delta has been deposited, is not of importance to the medical geologist; but he is interested in knowing the amount and composition of the suspended matter of the river, and, also the composition of the mud of the Delta itself.

In the month of April, 1838, Mr. Stein, at New Orleans, found the proportion of suspended matter to be  $\frac{1}{1488}$  in bulk, or about  $\frac{1}{16}$  in weight.

In the year 1844, the river being at a mean height, I took up from near



its middle, on the 31st of March, a bottle of water, eight hundred and sixty miles above New Orleans; on the 3d of April, another, four hundred miles lower down; and on the 10th, a third, opposite the city. These bottles remained closely corked until the 15th of May, when they were opened at the laboratory of Professor Riddell. On being uncorked, each emitted a sulphurous smell. By evaporation, we ascertained that the proportion of silt, by weight, of the first, was  $\frac{1}{1128}$  — of the second,  $\frac{1}{2388}$  — of the third,  $\frac{1}{3138}$ ; seeming to indicate a regular decrease on descending the river.

But the most important, and, indeed, the only series of experiments, are those made by Professor Riddell, from the 25th of May to the 18th of August, 1846.\* They show, *First*, That while the river continues at the same height, the quantity of silt may vary. Thus, for the first month after he began to experiment, the river being within three feet of high water mark, it did not vary more than a foot; and yet the amount of sediment varied to the extent of a third, and even a half. This is, no doubt, attributable to the predominance at different times of the water of different tributary rivers; and nearly connected with this is the fact, that in the summer, after the river has fallen to the mean height of the year, the proportion of silt may be even greater than before. Thus, on the 3d of July, when, by gradual subsidence, the height was only five feet seven inches above the lowest stage which occurred during his experiments, the quantity of silt was greater than at any previous period, even when the river was three feet nine inches higher. *Second*. His table also proves that, in the latter part of July, and thence forward, when the stage of low water is rapidly approaching, the proportion of silt is signally reduced, becoming at length not more than one-third of what it was in the period of high water. *Third*. As an average of all his experiments he obtained  $\frac{1}{1138}$ , by weight, of solid matter.

Let us turn to the composition of the silt while suspended in the river, and after its deposit in the Delta. This, of course, must be forever varying in quality, as we have seen it varies in quantity. Thus when several tributaries are swollen at the same time, the suspended matters will be different from those poured into the great trough by the freshet of any one of them; and again, each will supply a silt of a kind varying in some respects from every other.

In the month of June, 1844, when the river, at St. Louis, about twelve hundred miles from its mouth, was of mean height and rising, I took up a quantity of water at a distance from the shore, the sediment of which was analyzed by Doctor C. H. Raymond, a skillful practical chemist, of Cincinnati, who obtained from one hundred parts the following results —

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\* Com. Rev. of the South West, Vol. II, p. 435.

Silica, - - - - -	48.00
Alumina, - - - - -	18.50
Oxide of iron, - - - - -	14.00
Carbonate of lime, - - - - -	8.00
Phosphates of alumina and iron, - - - - -	1.00
Vegetable mold, or gelino, - - - - -	3.00
Undecomposed organic matter, - - - - -	7.50

\* 100.00

Desirous of knowing what elements were dissolved in the same water, I desired Dr. Raymond to analyze a portion of that which had passed through the filter; which he did, and obtained the following results, from one hundred parts—

Sulphate of soda, with a trace of the chlorides of lime and magnesia,	67.55
Organic matter, with a trace of silica, - - - - -	32.45
	<u>100.00</u>

We may, I suppose, assume that this organic matter, with traces of silica, consisted largely of the tribes of microscopic animalcules, discovered by Professor Bailey.

We are indebted to Professor Riddell for analysis of the mud of the Delta, at New Orleans. It was taken from the river's bank, and after being dried by a heat of two hundred and twelve degrees Fahrenheit, gave the following results—

Silica, - - - - -	74.15	Phosphoric acid, - - - - -	0.44
Alumina, - - - - -	9.14	Sulphuric acid, - - - - -	0.07
Oxide of iron, - - - - -	4.56	Carbonic acid, - - - - -	0.74
Lime, - - - - -	2.08	Chlorine, - - - - -	0.01
Magnesia, - - - - -	1.52	Water, - - - - -	3.12
Manganese, - - - - -	0.04	Organic matter, - - - - -	3.10
Potash, amount not determined,		Loss, - - - - -	1.03
Soda, " " "			
		Total	<u>100.00</u>

The silt obtained in these and all other experiments of a like kind, is the chief material of which the Delta is composed, at least in its more recent and superficial parts; but there is imbedded in it whatever solid matters may have been floated down and lodged in the estuary; which, of course, are chiefly the trunks and branches of trees and the bones of animals. Moreover, as the sea was always present, resisting, as it were, the encroachments of the land, we may suppose that marine exuvie are present to a greater or less degree.

The well-water obtained in such a heterogeneous deposit, cannot, of

\* NOTE, BY DR. RAYMOND.—In this analysis all the precipitates were dried to 212° Fahrenheit; at this temperature the alumina, oxide of iron, and carbonate of lime would retain water equal to about one-half of their weight.

course, be very pure. Professor Riddell\* has examined that afforded in the month of September, when the river was low, by a well, ten feet deep, in New Orleans. Under evaporation, it left a residuum of solid matter equal to a twelve hundredth part, by weight, of the water employed; but, in the month of December, the proportion was augmented to a ten hundred and ninety-fourth. This residue was of an olive color, and imparted a sharp taste. Examined with the microscope, nearly one-fourth appeared to consist of organized matters, such as the sporules, or germs of algae, and animalcules with their ova. The mineral ingredient proved to be —

Bicarbonate of lime,  
Bicarbonate of iron,  
Muriate of lime,  
Muriate of magnesia,  
Muriate of soda.

Being within six miles of Lake Pontchartrain, this well had perhaps been reached by percolation from that body of salt water, and was not, therefore, a fair representative of the wells of the Delta generally; nevertheless, they must everywhere afford water abounding in impurities.

Wherever examination can be made, as along the river and in some excavations by art, it is seen that these materials have been deposited in horizontal layers. I may refer to two perforations as instructive in regard to the geological structure and composition of the Delta. *First.* Professor Riddell informs us, on the authority of M. W. Hoffman, Esq., that north of New Orleans, near Lake Pontchartrain, in the year 1828, Mr. Harvey Elkins bored to the depth of two hundred and seven feet. Thirty feet below the surface, fragments of Indian pottery were brought up; and part of a deer's horn, recent shells, and bones of land animals, were occasionally raised. The stratum in which the boring was stopped, consisted of a hard, blue siliceous clay. Brackish water, with volumes of some kind of gas, arose.†

*Second.* In the year 1844, I visited two gas tanks, each sixty feet in diameter, and sixteen feet deep, recently sunk in the back part of the city; and received from the intelligent superintendent, Doctor Rogers, an account of what was met with in excavating them. At first, they encountered soil and soft river mud; then, harder laminated blue alluvion; then, deep-black mold, resting on wet, bluish quicksand, so moveable that they could not proceed further. On this the brick walls of the tanks were laid, and the sinking under their weight was so unequal as to produce curves in the ranges of brick, which, of course, were at first horizontal. A pile of brick laid in the center of one tank, caused the center of the adjacent tank to bulge up. The roots, and bases or stumps, of no less than four successive growths of trees, apparently cypress, were found standing at different elevations. The first had a diam-

\* Hist. Notice of New Orleans, 1840.

† Com. Rev. of the S. W.



ctor of two feet six inches; the second, of six feet; the third, of four feet; and the fourth, of twelve feet at a short distance up, with a base of twenty-eight feet for the roots. It was imbedded in a soft, deep-black mold. When cut with the spade, much of this wood resembled cheese in texture, but hardened on drying. This statement was confirmed by Mr. Kelvy, who conducted the excavation. At the depths of seven and sixteen feet, burnt wood was met with. No shells, or bones of land animals, or fish, were observed; but in a tank previously excavated, at the depth of sixteen feet, the skeleton of a man was found. The cranium lay between the roots of a tree, and was in tolerable preservation, but most of the other bones crumbled on exposure. A small *os ilium*, which I saw, indicated the male sex. A low and narrow forehead, moderate facial angle, and prominent, widely separated cheek bones, seemed to prove it of the same race with our present Indians. No charcoal, ashes, or ornaments of any kind, were found around it. In the bottoms of the tanks there was a constant boiling up of brackish water, varying in temperature in different fountains, from eighty to eighty-two degrees—the observation being made on the 3d of May. As this temperature approached much nearer to that of Lake Pontchartrain than the Mississippi, it showed, not less than the brackish taste of the water, the subterranean influence of the Lake, although at the distance of four or five miles from its margin.

On examining this water in the Laboratory of Professor Riddell, we found in it a liberal quantity of muriate of soda, with some muriate of magnesia, and a trace of muriate of lime; no sulphuric acid or iron was present. Along with the water there was a constant evolution of gas, which proved to be carburated hydrogen.

In these excavations, no fragments of rock or rolled pebbles were encountered; and none are found in the banks of the river, or on the surface generally.

The coarse sands of the Missouri, found also in the Mississippi for many hundred miles below the junction of those rivers, are not met with here, as only the very finest can be suspended long enough to reach the Delta. Nevertheless, it is more silicious than a casual inspection would lead us to suppose.

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## SECTION VII.

### VEGETATION.

I. The native tree and shrub vegetation of the Delta is composed of such species as delight in a warm, rich, and wet soil. None are so aquatic as to flourish in deep water, but many grow in swamps which are never dry. The Liquidambar everywhere abounds. The Cypress, equally abundant, enjoys the unenviable distinction of giving its name to every swamp; but is, at the

same time, endowed beyond every other tree with a garniture of the long moss, which is to be met with everywhere as we ascend the river, until we pass beyond the Delta, up to the latitude of thirty-three degrees thirty minutes. The Live Oak (*Quercus virens*), preferring the sandier and dryer soils, is found from the shores of the Gulf to the thirty-third degree of latitude. The *Magnolia grandiflora* shows the same preference, and is found in nearly the same latitudes. The *Sassafras* grows to great dimensions. The Pecan (*Carya oliviformis*) shows, by the size and excellence of its fruit, that this locality is more congenial to it than that of Illinois. The single-seeded Honey Locust (*Gleditsia monosperma*) to a great degree replaces the *Gleditsia triacanthos*; the *Celtis crassifolia* represents the Hackberry (*Celtis occidentalis*); while the two Buckeyes of the interior (*Asculus*), the Papaw (*Anona*), and the Sugar Maple are wanting. The Cotton Tree and Sycamore, less conspicuous than in the interior, nearly disappear in the southern part of the Delta; but on the other hand, the Elder (*Sambucus*), which is without an erect trunk in the colder climates, here becomes a small tree; and the *Bignonia radicans* (Trumpet flower), and *Smilax laurifolia*, climb to the greatest height. The native Cane (*Miegia macrosporma*) rises to a gigantic height where deep and prolonged inundations do not occur; The *Chamærops serrulata*, or Fan-Palm, called Palmetto by the people, the *Sabal adansonii*, or small Fan-Palm, and Black Willows (*Salix*) of a large size, take its place. As we descend the narrow cape which projects into the Gulf and sinks nearly to its level, most of the trees which have been named disappear, leaving the last three in undiminished vigor. Down to the lowest extremity of this tongue of new land, tufts of Mistletoe (*Viscum album*), seen as far north as the fortieth degree, continue to show themselves; and remind the voyager of the upland forests of the interior, when no other familiar object meets his eye.

The plan of this work does not permit, or demand, a more extended notice of the native Sylva of this region; and I shall conclude with the remark, that the great current which transports and deposits the soil of the continent in the Gulf, also brings down the seeds of the forest trees generally. Many perish in the heat and moisture of the new locality, but many others germinate and flourish; and thus the catalogue common to the two regions might be much augmented, if this were an occasion which required it.

II. In further illustration of the climatic and topographical condition of the Delta, it may be proper to notice a few of its cultivated exotics. Its first staple was Rice, which is still cultivated above and below Fort Jackson, midway between New Orleans and the Balize. Indigo was once successfully cultivated, but is now neglected. Cotton flourished well, but has been almost superseded by Sugar Cane, the northern limit of which is about thirty degrees thirty minutes. The Peach tree grows and bears luxuriantly, but the Apple finds the soil and climate too warm for the growth and ripening of its fruit. The Orange bears the open air as far north as the Sugar

Cane, but at that point is liable to be destroyed by the frost, and its fruit is sour: on the neck of land below New Orleans, the climate is more congenial to it, and the fruit is sweet. The Fig tree attains to its greatest height, and bears a delicious fruit. The Grapes of the interior do not succeed; and Wheat cannot be cultivated.

## SECTION VIII.

### SALUTARY INFLUENCE OF THE JUSSIEUA GRANDIFLORA.

The Delta, from the latitude of New Orleans down to the Gulf, and west of the city, to its termination on the further side of Bayou Teche, has much uniformity of physical character. It abounds in lakes, from Barataria near the city, to Chetimaches beyond the Atchafalaya; and is traversed by a great number of small bayous, in addition to the larger enumerated in the first Section of this Chapter. It includes the fine and flourishing settlements of the La Fourche, the Teche, and the Attakapas, all of which appear to be as little affected with autumnal or yellow fever as the Mississippi coast above the city. Doctor Cartwright, of Natchez,\* has ascribed this exemption to the influence of a plant, the name of which stands at the head of this Section. I propose to transcribe so much of this paper as will present his views, and thereby promote further inquiry. After a brief topographical outline, he proceeds:—

“Nearly the whole surface of many of the bayous, and a considerable surface of many of the lakes, in all that part of Louisiana below thirty degrees of latitude, are covered, in a greater or less degree, with the *Jussieu grandiflora*, the plant which possesses hygienic or health-preserving properties. Besides the *Jussieu grandiflora*, I observe a considerable number of other aquatic plants, both phænogamous as well as cryptogamous. Among the aquatic plants were the *Callitriche aquatica*, or water star grass; the *Lemna minor*, or Dutch ment; the *Riccia natans*, or floating liverwort; the *Nympha cærulea*, with its broad leaves; the *Isnardia palustris*, with its grass-like leaves; besides the *Rafflesia arnoldia*; *Lemnochæris humboldtii*; the *Hydrocotyle vulgaris*; and a few others. On the bays, the *Pucus natans*, or gulf weed, was very common. Nearly all the aquatic plants, with the exception of the *Jussieu grandiflora*, the *Lemna minor*, and the *Pucus natans*, had more or less attachments to the soil by means of roots. The *Pucus natans* was only found in salt water. The *Lemna minor* is a very small and insignificant plant. The *Jussieu grandiflora*, however, is exclusively aquatic. It is a large flowering plant, which grows three or four feet above the surface of the water, and gives the water on which it grows the fallacious appear-

\* Western Journal of Medicine and Surgery (Louisville), Vol. I, p. 428.



ance of a natural meadow. The root is several feet in length; is jointed; about half an inch in diameter; lies horizontally on the water, but an inch or two below its surface. Each joint sends up the culm or stem of the plant; and around each joint of the root, at the foot of the stem, are a great number of radicles, or hair-like roots, some of which float on the surface of the water, and others dip down toward the bottom, or fasten themselves to old logs. These radicles, or little roots, often have adhering to them an inky kind of paste or substance, which is collected from the water, and no doubt constitutes the nourishment or proper aliment of the plant to which they belong. The roots, radicles and radicle leaves of the *Jussiaea grandiflora*, form such a dense covering to the water, as to constitute a bridge sufficiently strong to enable snakes and grasshoppers to cross over the stagnant pools in which it grows. I traveled forty miles in a canoe through bayous and lakes which were almost entirely covered by the *Jussiaea grandiflora*, intermixed with a number of other aquatic plants. I was often unable to see any water at all, except in the track made by the canoe. Although very frail, and easily pushed aside or broken, this floating plant afforded considerable resistance to the progress of the canoe. On the wide bays and lakes, the winds often detach large masses of this and other aquatic plants, which being driven about by the waves, and one detachment forced upon another, constitute what are called *floating islands*—which are often strong enough to bear the weight of a man in a recumbent posture. The *Jussiaea grandiflora*, together with the other aquatic plants mentioned, we not only found on the lakes, bays and bayous, but they constitute the substratum of that singular and nondescript species of savannah called the *prairie tremblant*. These prairies are constituted, in the first instance, of a vast assemblage of aquatic plants. On this vegetable stratum, intermixed with the debris of their vegetable substances, a number of grasses and terrestrial plants, like parasites, fasten themselves and grow. The whole is formed into a complete vegetable mattress, strong enough to support a man in a crawling position, but not sufficiently firm to enable him to walk upright. It is also too firm to admit the passage of a canoe. When the foot is placed upon it, the whole mass trembles; hence the French name *prairie tremblant*, and the English name *shaking prairie*. It is said, that if a hole is cut in it, fish may be caught with a hook and line.

"The facts on which I rest the hygienic, or health-preserving properties of the *Jussiaea grandiflora* are—

"*First*. That it purifies all stagnant water in which it grows.

"*Second*. The remarkable exemption of the inhabitants of that section of Louisiana from malarious or miasmatic diseases.

"1. The water on which the *Jussiaea grandiflora* grows, differs essentially from other water, similarly circumstanced, where this plant does not grow. Although I visited the country in which the plant is indigenous during a very dry and hot season, in the month of June, I found the stagnant

water of the lakes and bayous inhabited by this plant, as pure to the sight, taste, and smell, as if it had just fallen from the clouds. Near the Gulf of Mexico, however, the water of the bayous was impregnated with salt. The water also of Bayou Black, although fresh, had a darkish appearance — owing to a chemical affinity between some ferruginous matter in the soil, and the oak trees and leaves which had fallen into the water. The water of Bayou Black, although of a dark color, was free from any disagreeable taste or smell. It contained no green scum, and was considered to be equally as good and palatable as distorn water, except near the Gulf, where the water is impregnated with salt. The inhabitants who reside on the margins of the stagnant lakes and bayous of that part of Louisiana, drink no other kind of water.

"I could discover no other cause for the remarkable purity of the stagnant water in the lagoons, swamps, lakes, and bayous of lower Louisiana, than the aquatic plant under consideration.

"North of the region where the *Jussieu grandiflora* flourishes, there is the same kind of alluvial soil, formed by depositions of the identical rivers which form the soil of Lower Louisiana; yet stagnant water, in hot weather, becomes exceedingly impure, beyond the limits in which the plant under consideration is found. The soil, therefore, cannot occasion the purity of the water of Lower Louisiana, because the same kind of soil, a little further north, has not the same effect. Nor can the purity of the water be owing to the salt or sea water; because the water is equally pure, wherever the aquatic plant grows, whether in salt water or fresh.

"I think it may be fairly inferred, therefore, that the aquatic plant known by botanists under the name of *Jussieu grandiflora*, consumes or feeds upon those substances which in other situations corrupt and vitiate stagnant waters in a warm climate.

"2. The remarkable health and longevity of the inhabitants, and their exemption from malarious and miasmatic diseases. The fact, that the region of country in which this aquatic plant abounds is exceedingly healthy, can be established beyond cavil or dispute. It nevertheless contains more stagnant water and swamps, than any other inhabited district of the same extent in the United States.

"The country immediately north of the line bounding the growth of the floating plant (which is about the thirtieth degree of north latitude), like that south of the thirtieth, is alluvial, contains lakes, swamps, and stagnant waters — is covered with nearly the same vegetable productions; but its atmosphere is evidently insalubrious, its stagnant waters impure, its inhabitants sickly, and human life of short duration; while the country of the aquatic plant, immediately south of it, contains a wholesome atmosphere, pure water, healthy, and long-lived inhabitants. It may be supposed that this country is too new and too thinly inhabited to enable us to form any correct estimation of the health and longevity of its inhabitants. Such a supposition is

erroneous. Although a considerable part of the region abounding in the aquatic plant is uncultivated and almost uninhabited, yet a very considerable portion of this territory has been settled nearly a century. A large colony from Nova Scotia emigrated to it before the revolutionary war. Some of the settlements south of New Orleans contain more free white inhabitants to the square mile, than the oldest and most populous settlement in Pennsylvania.

"It may be said that the inhabitants are the descendants of French and Spanish, and consequently no just comparison can be drawn between them and the descendants of the English. It is true that a large portion of the inhabitants are of French extraction. A large settlement of them on the La Fourche, within this region, were born north of the United States, in the cold latitude of Canada. Colonel Sparks, an intelligent planter, who resides on Bayou La Fourche, in the midst of the colony which emigrated from Nova Scotia more than half a century ago, informed me, in 1881, that a great number of the emigrants were still living. He took me to a number of their houses, and his statements were confirmed by the inhabitants themselves. I saw more than a sufficient number of gray heads, and healthy looking children, to remove all skepticism in reference to the health and longevity of its inhabitants. Besides the French population, this particular section of country has spread through it a number of Italians, Spanish, Dutch, German, Irish, English, and Scotch. It also contains emigrants from almost every state in the Union. The negro population is also considerable, and is remarkably healthy and long-lived. It contains more negroes over one hundred years of age, than five New England states put together, including the whole population, white and black. The population of this land of aquatic plants, owes its origin to so many different nations, that it is not uncommon for the Creoles, or natives of the country, even when uneducated, to speak with great ease three or four different languages. If it were true, which it is not, that the French people are exempt from miasmatic diseases, such as bilious, remittent, and intermittent fevers, it would prove nothing; because the Germans, Spanish, Italians, Scotch, Irish, and English, together with the negroes and emigrants from the states north of Louisiana, are all, in this land of aquatic plants, singularly exempt from such diseases. But neither the French nor any other race of people are thus exempt, when they cross the line which terminates the growth of the floating plant. It is, therefore, a fair inference, that this plant, by consuming the impurities of the stagnant waters, prevents the generation of miasmata, and thus acts as a prophylactic against bilious fevers, and other miasmatic diseases.

"I am aware, that the inhabitants of the country themselves attribute their peculiar healthfulness to the influence of sea breezes. Out of the region of the floating plant, sea breezes, however refreshing and beneficial to some constitutions, have not been found to exert a prophylactic power in preventing miasmatic diseases. It is not probable that the sea breezes



would do more good for the sea-coast of Louisiana, than for the sea-coast of Georgia, Carolina, Virginia, and Maryland.

"In the summer of 1881, I traveled extensively through Lower Louisiana, and am fully convinced, from what I saw and heard, that the particular district of country in which the floating plant abounds is preëminently healthy, while those sections of the State, similarly situated, but where the aquatic plant was not found, are grievously afflicted with malarious diseases.

"I visited, among others, the plantation of M. Roehello, on a small bayou, near Berwick's Bay. The dwelling-houses stood on the high ground about a quarter of a mile from the bayou. The space between the bayou and the houses was occupied by a swamp, through which a canal had been cut to afford access to the high ground or bluff, on which the dwellings stood. M. Roehello, a few years previously, had the trees covering the swamp in front of the houses cut down, in order to gain a better view of the bayou, and obtain a freer circulation of air. As I passed up the canal or ditch, through the swamp, I perceived, on each side, the decaying timber lying in the water, which was entirely stagnant. In many places the water was not sufficient to cover the ground. On ascending the bluff and looking around, I ascertained, that besides a swamp of a quarter of a mile in width, and three miles in length, in front of the plantation, there was an immense swamp in the rear, running back to a *prairie tremblant*; and on the lower side of the plantation was another bayou of stagnant water, and on the upper side a thick forest and cane-brake. I thought, at the time, that if the country contained a sickly spot, this was one. The *Jussiaea grandiflora*, however, grew in profusion in all the waters around, whether these waters were in the bayous, or in the swamps; and whether they had communication with the bayous, or were isolated stagnant pools, they were found to be pure and transparent—free from any offensive taste or smell.

"M. Roehello had fifty-three negroes living on this plantation, and his white family consisted of about a dozen persons. He informed me, that himself, and all the family, white and black, except the younger children, were natives of Roanoke county, Virginia—that he had resided on the plantation with this large family nine years, during which time no death had occurred, either among the whites or blacks, young or old—that there had not been more than three or four cases of sickness during any year—that these cases were slight, and required little or no medical treatment. His neighbors confirmed this statement, and gave nearly as good an account of themselves. The negroes with whom I met all looked healthy, happy, and contented.

"The next evening I put up at a house containing about twenty white persons and no negroes. The patriarch of the family was a Kentuckian by birth. He married a Spanish woman, who, dying, left him a widower with several children. He afterward married a French widow with two or three children, whose former husband was a German. The children by the last

marriage as well as by the former marriages, together with a few aunts and other relatives, swelled the whole family to about twenty. No less than four languages, English, Spanish, German, and French, were spoken by the same family, living under the same roof. I got two of the sons of the old gentleman by his first wife, to take me in a canoe up Bayou Black. They were with me several days, and, as they spoke four languages, were of great use in enabling me to collect information respecting this country, inhabited by the floating plant and polyglot people.

"If I have been misinformed in reference to the health of this section of the country, there also are great numbers, in and about this city, deceived in this respect equally with myself. Numbers of people, in and about Natchez, have visited this region of country; some have removed to it; a few have been living in it for years. All with whom I have conversed, concur in the same opinion of its healthfulness. It is true, they differ in regard to the causes of its singular salubrity; some ascribing it to the proximity of the sea, and the sea breezes; others, to the large open prairies on its western border, in and near that part of it called Attakapas, without recollecting, that the inhabitants of Terrebonne and La Fourche, who reside very remotely from these large prairies, and secluded from them by intervening forests, are equally, if not more healthy than those living near them."

Apart from the conclusions of Doctor Cartwright, this extract will be regarded as valuable, from the information it communicates on the topography of that region, and the composition of its society, not less than its general salubrity. Of its exemption from autumnal fever, I am disposed to think, however, that Doctor Cartwright speaks in language rather too unqualified; though no stronger, doubtless, than the facts given him by the people during his visit demanded of him. When at New Orleans, in the spring of 1840, I met with Doctor Walter Brashear, an aged and highly intelligent physician, formerly of Kentucky, but long resident on the Lower Atchafalaya, in the midst of the Jussieu, who informed me, that intermittent and remittent fevers prevail annually in that region, but on the whole, are mild — less fatal, indeed, than in Kentucky.

On the hypothesis of Doctor Cartwright, without either adopting or rejecting it, the following remarks may be made:

1. The 'coasts,' as they are called, or banks of the Mississippi, from New Orleans to the outlets of Bayou La Fourche and Bayou Plaquemine, (lying nearly north of the region where the Jussieu is supposed to destroy the cause of autumnal fever), are equally exempt from that disease, and equally abound in aged Creoles, although there are no lakes and no Jussieu; but the river is on one side, and cypress swamps are on the other. I was prevented from visiting the district where the Jussieu grows, but traveled on the coasts.

2. If we examine the locality which the Jussieu overspreads by the facts furnished by Darby, Cartwright, and others, we do not find that it

abounds in those elements to which malaria is generally ascribed. Lakes, in themselves, are certainly not of that kind. The bayous, those writers inform us, are natural canals, several feet deep, in which the tides of the Gulf daily librate. The central belts between them, called shaking prairies, are lakes bridged over with matted plants; for fish may be caught by perforating their trembling crusts. The narrow zone of palmetto swamp, which skirts the shaking prairie, is nearly destitute of annual vegetation; and the leaves of that shrub are perennial and most difficult of decomposition. Then comes the narrow tract of cypress swamp, densely overshadowed, and equally devoid of herbaceous vegetation. To this succeeds the belt of cane-brake and deciduous forest trees, so dense that a bird cannot fly through, nor a sunbeam reach the surface, which of course can sustain no succulent annual plants; then a belt of live oak, a quarter of a mile in breadth; and lastly, the narrow zone of long-cultivated, arable land, terminating in the lake or bayou. Compared with the other varieties, the tillable portions do not make a third; and they are no longer subject to the inundations of the Mississippi, which for ages could not have thrown upon them, by its overflowings, any great amount of organic matter; as most of it, in so long a voyage, is either deposited above, or decomposed, or so comminuted, that it remains suspended until the inundation gradually sinks into the Gulf. Thus, *a priori*, we should not expect to see as much autumnal fever in that region, as in those further up the river.

3. Dr. Cartwright ascribes the transparency of the lakes in which the *Jussiaea* floats, to the action of that plant; but may we not, as plausibly, say, that it prefers clear to turbid waters? With these facts before us, we should, I think, regard the preventive power of the *Jussiaea* as an open question.



## CHAPTER V.

## THE SOUTHERN BASIN, CONTINUED.

## LOCALITIES IN AND AROUND THE DELTA OF THE MISSISSIPPI.

## SECTION I.

## MILITARY POSTS.

I. FORT LIVINGSTON.—On the marine border of the Delta (*Pl. V*), three quarters of a degree directly south of New Orleans, near the mouth of Bayou La Fourche, and at the junction of Barataria Bay with the Gulf, lies the island of *Grand Terre*. Rising about two feet above the highest tides of the Gulf, it has a surface of dark sand, covered with grass, overshadowed with small live oaks. There is sufficient soil for the successful cultivation of melons, and other garden vegetables. From the middle of May to the middle of August, there are land and sea breezes; but the former often fail, and the latter not unfrequently continue all night. For the remainder of the year the winds are variable. In the year 1844, I received the foregoing facts from Captain Barnard, of the United States Corps of Engineers, who had been stationed for four years on the island, engaged in the erection of a Fort. The mean population through that period was fifty, of which four-fifths were negroes. Of the whites, many were directly from the northern states. Captain Barnard was unable to recollect a single case of intermittent fever at that Post during the four years, and but one of remittent fever; the subject of which arrived with the disease upon him. The same was true of yellow fever; not a case of which had occurred, notwithstanding the usual intercourse with New Orleans, through Lake Barataria, had been kept up while the fever was epidemic in that city. Winter diseases he declared to be unknown.

II. FORT PIKE.—The *Island of Petites Coquilles*, of which the north side is the site of Fort Pike, lies between Lake Pontchartrain and Lake Borgne, thirty-five miles north-east of New Orleans. Its area is seven by twelve miles; its elevation over the Gulf, two feet. Small shells, with an intermixture of argillaceous deposits, brought down by Pearl River, make up its composition. It is intersected with numerous bayous of salt or brackish water; and all the marshes near or upon it contain water of the same kind. The soil is fertile. In the summer, the prevailing wind is from the south-

east, and consequently from off the Gulf. Although so near to New Orleans, Fort Pike has constantly remained exempt from yellow fever; and autumnal fever is far from being prevalent, the ratio of intermittents being nineteen, and of remittents seven per cent.\*

III. **Fort Wood.**—This Post is distant but seven miles from the last. Its site is on the south side of the pass or channel called Chef Montour, one of the connecting straits between the two lakes. In its rear there are marshes and cypress swamps, such as cover the isthmus between the lakes and the Mississippi, which are annually replenished with fresh water. Compared with Fort Pike, this Post is decidedly insalubrious. It has been invaded by yellow fever, and the ratio of autumnal fever is high; that of the intermittent form being seventy-six, and of the remittent twenty-seven.

The remarkable difference in autumnal salubrity between these contiguous Posts, is ascribed to the existence of salt marshes near Fort Pike, and fresh-water marshes near Fort Wood.†

IV. **Fort St. Philip and Fort Jackson.**—These Posts are on opposite sides of the Mississippi, about seventy miles below New Orleans. The former, built long since by the French, was abandoned in 1831, for the latter; which stands on the right bank of the river. Situated only thirty miles from the mouth of the Mississippi, these Posts are on the *newest* land of the continent. The cypress swamps here almost reach the river; the banks of which, composed of fine silt and vegetable remains, are so low, that a rise of three feet produces an inundation. They generally remain covered with water from March to June; and when the water subsides, it leaves a new layer of mud and organic matter, which, under the action of a powerful sun, sends up an offensive odor. A strong wind from the Gulf, even when the river is low, may retard its waters, and produce a deluge, followed by a similar stench.

St. Philip was always a sickly station; the same is true of Jackson. Autumnal fever prevails for six months after the fall of the river in June. The ratio of intermittents is one hundred and fourteen, that of remittents fifteen per cent.; and these ratios would have been higher still, if the troops had not, at the coming on of the sickly season for two years, been removed to Posts higher up the river. Malignant cases, however, were not numerous, but relapses incessant.‡ Yellow fever does not seem to have prevailed here.

The *Rice lands* of the Delta, are the narrow banks of the Mississippi, near, but chiefly above, Fort Jackson. They are cultivated mainly by whites, who, as Doctor Randall informed me, are not particularly unhealthy; and Mr. Moor, who resides in their midst, assured me, that he found his locality healthier than the one he had left in Ohio. Low levees, which terminate

\* Med. Stat. U. S. A., p. 270.

† Ibid, p. 275.

‡ Ibid, p. 279. Dr. B. Randall, U. S. A., MSS. pen. me.

about Fort Jackson, restrain the river above that Post. The peninsula here is so narrow, that the Gulf, especially on the east or left side, is almost constantly in view.

## SECTION II.

### THE BALIZE, AND MARINE EXTREMITY OF THE DELTA.

I. TOPOGRAPHY AND SOENRRY.—We have come, at length, to the most remarkable spot of the continent. In reaching it from the north, as, for example, from the sources of the Mississippi, we travel successively, *first*, on primitive, unstratified, crystalline formations; *second*, on ancient, stratified, semi-crystalline rocks, the whole purely mineral, and as destitute of organic forms as of organic matter; *third*, on old secondary rocks, imbedding, in the fossil state, the habitations of marine animals only, and they of species long since extinct; *fourth*, on formations composed in part of the remains of gigantic tropical plants, though lying in the temperate zone; *fifth*, on deposits containing fossil marine forms, bearing some resemblance to those found in the existing seas; *sixth*, on deposits enveloping various animal remains, both of land and sea, most of which have living archetypes; *seventh*, on tracts so recent as to contain only existing species of animals and plants; which brings us into the locality which has been announced where the work of land making is in actual progress, and we are shown the process of building up a continent from the bottom of the sea. To the medical geologist and topographer, such a locality cannot be destitute of interest; as it affords an opportunity—the only one within the limits of our Great Valley—of contemplating the relations, in a hot climate, between the newest land and the first forms of vegetable and animal life which overspread it; together with its effects, on the health of the first human inhabitants by which it is peopled.

The Mississippi advances into the Gulf by extending its own trough; to which end, the very resistance of the sea is made to contribute; for its waves roll back the sediment which has been carried out, and press it against the growing extremity of the trough, as the weaver's beam drives up the thread; and thus a bar is formed. Through this bar, the river continues to cut its way; leaving, on either side, the reflux silt, as the beginning of new banks, which are, therefore, at first submarine. In this natural masonry, the drift-wood of the river performs an important part. Becoming entangled and fixed, the silt collects around, and is condensed by it;—thus giving us the prototype of our brush-dams across the alluvial streams of the interior. Hence, before the bank has yet been raised above the surface of the Gulf, its place may be discovered by the projecting limbs of trees, which serve instead of buoys to indicate the channel.

Like a skillful architect, the Mississippi lays a broad and deep foundation



on which to extend its aqueduct. When the waters escape from the terminal extremities of the different Passes, they spread through a semicircle until the currents are arrested; and thus diffuse their sediment over a broad surface, having less and less to throw down, the further they advance from the axis of diffusion. By sounding on a line drawn from this axis, the water is found to deepen at the rate of a fathom for every mile;\* which shows the ratio of inclination of the alluvial plain beneath the level of the sea. The annual floods of the river occasion a long-continued inundation of its banks; during which, deposits are made upon them; and thus the work of extension and that of elevation, proceed simultaneously. From the great altitude of the mountains in which the Missouri River originates, and the loose texture of the broad plain over which it flows, there can be no limits to the advancement of the bed and banks of the Mississippi, until it traverses the Gulf of Mexico and unites its right bank with the peninsula of Central America — forming a salt lake on the west; or pours its waters into the Caribbean Sea between Yucatan and Cuba, or mingles them with the Gulf Stream in the Florida Straits.

But let us return to the present time, and contemplate the existing condition of this advancing extremity of the Delta. For fifty miles before we reach the Gulf, small passes or channels are seen on each side of the river, through which its waters escape, in liberal quantities, during every flood; and thus give lateral extension to the great submarine platform. As we descend, these lateral currents multiply, and may be produced at any point, by a little excavation through the low and soft banks. Many of them are navigated by the boats of oystermen and fishermen; who thus make their way by short cuts to the salt water. One, just below Fort Jackson, begun by art, was soon widened and deepened by the river, so as to permit the access to the Gulf of much larger vessels. After the river has divided into three great Passes, South West, South, and North East, the side bayous still show themselves. The banks are here so low, that it is difficult to find ground on which to build; and as they are often overflowed by waves from the Gulf, not less than by floods in the river, the scattered habitations, all constructed of wood, are elevated on blocks. They are, however, continually sinking; for beneath the partially hardened silt, there is a soft mud, into which, after perforating the crust, a pole may without difficulty be sunk to any depth, unless arrested by buried drift-wood.

As we descend the Mississippi towards its division into great Passes, constituting the apex of what may conveniently be called the Balize Delta, tree after tree disappears. Immediately below Fort Jackson, the species become few, and the individuals are sparse and of reduced size. The cypress and liquidambar fail; but an ash, the sycamore, the one-seeded honey locust,

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\* *Med. Stat., U. S. A., p. 270.*

the thick-leaved hackberry, and the cotton tree, still show themselves, with now and then a live oak. Luxuriant tufts of mistletoe are occasionally seen, and festoons of long moss are not wanting, though less profuse than higher up the river. The grove is at last reduced to palmettos, arborescent olders, and gigantic black willows; the last of which venture further into the waters than all the rest, and finally come to be nearly the sole representatives of the forest. But in passing beyond the limit of the woods, we do not leave the vegetable kingdom, for the eye rests on boundless fields of reed-grass (*Phragmites communis*), the culms of which rise to the height of fifteen or twenty feet, and in appearance replace the cane-brakes, which luxuriate on the higher banks of the river, but cannot flourish with their roots steeped in brackish water. From the upper deck of his steamer the traveler here sees the grand system of natural canals, into which the Mississippi finally divides; and contrasts the color of their turbid waters, with the greenish tint of those with which they are about to mingle. Each canal has its winding vista, and when buried too deep in the distant jungle to be seen, its banks are indicated by ranges of willow trees. Between the principal Passes, there are shallow ponds of brackish water, with mud bottoms; but salt marshes, too soft in most places to be passed over by men or cattle, constitute the greater part of the surface. In the more fluid parts of these marshes, we find the reed-grass less abundant; but the *Typha latifolia*, *Scirpus lacustris*, and other aquatic plants, become more numerous.

Of animals, herons and other wading birds, wild geese, gulls, eagles, and the purple grackle, are common; the banks of the bayous are perforated by millions of the fiddler crab, with one large and one small claw; now and then a porpoise ascends the stream by successive vaultings, which carry his back above the surface; an otter sports or dives along the banks; and alligators, in multitudes, lurk in the jungle which overhangs them.

II. GEOLOGY. As in the general Delta, so in the subordinate or Balize Delta, there are three great geological elements—silt, drift-wood, and the remains of plants and animals which grow upon it. The amount of drift-wood is much less than is generally supposed. Arrested by the tides, it lodges in the recesses of the bayous, where it becomes fixed by silt, and willows soon take root upon it; while that which lies in the brackish water is bored in all directions by the *teredo navalis*. Gradually penetrated with silt, it becomes semi-fossilized, and ultimately constitutes an integral part of the formation. As most of the plants growing on the spot are gramineous, with culms containing siliceous matter, their decomposition is slow, and undecomposed beds no doubt exist beneath the surface at every depth. To these remains must be added those of the *testacea*, which inhabit all the inlets and little bays, which are filled with the waters of the Gulf. Finally, these waters penetrate the Balize Delta, and impregnate the whole formation with common salt; which effloresces whenever the surface dries. Thus immersed in weak brine, the organic

matter, either resting on the surface or buried beneath, may have its decomposition protracted and essentially modified.

The bars are ridges formed as already intimated, by the conflict of the moving waters of the Gulf and river. They advance gradually into the former; which contends, but still recedes. The ratio of this advancement has not been accurately ascertained. Mr. McCullough tells us,\* that while he resided, for five years, near the bar of the South West Pass, it advanced into the Gulf a quarter of a mile. Mr. Vanderslice, an observing and reliable pilot at the Balizo, informed me that the bar of the North East Pass had advanced nearly half a mile in eleven years. These data would give five miles in one hundred years. Other data have both augmented and diminished this ratio. No doubt, different bars (and even the same at different periods) are pushed forward at varying ratios, according to the quantity of water directed against and over them. Thus, at the present time, very little flows in the South Pass, compared with the South West, and its advance, we may presume, is correspondingly less. A channel, made by dredging transversely through the middle of the bar in the North East Pass, was soon filled up by the subsidence into it of the soft, unsupported walls of the ridge left after the dredging.

Portions of the bars present, at times, a sort of intumescence, or bulging up, which, after a while, disappears. The first notice of this movement, which I recollect to have seen, was by Mr. William McCullough, in 1837. When at the Balizo, six years afterwards, I made this phenomenon the subject of inquiry, and from the late Captain Taylor, boarding officer of the port, Mr. Vanderslice and other respectable pilots, I obtained the following facts.

1. A sloop was lost on a breaker near the entrance of the North East Pass. The water was merely deep enough to cover her. After having been almost a year out of sight, she began to reappear, and in the course of an equal length of time, even her lowest timbers were three or four feet out of water. The area on which she rested was estimated at an acre and a half. While on her way up, the waves tore off her planks, washed out the silt, and exposed her ballast, much of which was taken out. In the course of another year, both the bark and schooner had disappeared.

2. A vessel grounded near or in the same Pass, and to lighten her, the ballast, consisting of bricks, was thrown overboard, in water eight or nine feet deep. In less than a twelve month, the bricks appeared above the surface, resting on a mud bank. Many of them were brought into the Balizo. Not long afterwards, those left behind, with the bank on which they rested, sunk gradually below the surface, but not to their former depth; for the water has since been shallower over that spot than before.

3. At the same Pass, a ship from Liverpool, having no ballast, curb-stones, for use in New Orleans, required to be lightened; which was done by

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\* Documents, p. 77.



throwing them overboard, in water fifteen or sixteen feet deep. In a little more than a year, they began to show themselves above the water, and the bank on which they rested, continued rising, until its surface, to the extent of half an acre, was five or six feet out of water. In a few months it began to subside, and at length disappeared. But the water is not so deep at that spot as before.

4. A vessel called the Condor, after losing her anchor in water nearly eighteen feet deep, was herself sunk in still deeper water. In the ensuing year the anchor was raised until it was only three feet beneath the surface, but nothing was seen of the ship.

These various masses of mud, became so hard under exposure to the sun, that men could walk upon them. They disappeared either by sinking or by the action of the waves; but we come now to examine others which have remained permanently above the surface of the Gulf.

In various places along the marginal line of this long, alluvial cape, are islets, the present elevation of which above the Gulf could not have been the result of deposits from the river. Mr. McCullough mentions one near the South West Pass, which was twelve feet above the surface of the Gulf and had received the name of Gibraltar. Another, at the same Pass, on which he resided, was eight feet high; but subsequently had sunk to four.

At the mouth of the Pass a la Loutre, I visited one, the highest points of which were only three or four feet above the water, which was shoal all around it to the extent of many acres. Its surface was firm, but not dry; for the spray of the Gulf, and, to some extent, the waves, dashed over it, and had manifestly reduced its altitude. Great numbers of water-fowl made it a place of resort. By the action of the rains and waves, the surface was cut into miniature river channels, inlets, and bays, sometimes filled with water, and at others empty. The surface was a stiff, blue clay, fragments of which, rolled by the currents, had become smooth and molded into spheroidal, oval, or reniform masses, resembling the rolled pebbles of the interior of the continent. The whole structure of the island, as seen where channels had been cut in it, was stratified or lamellar, with a dip or inclination to the north. It did not contain either fragments of rock or fossil wood.

In front of the Balize Bayou, a branch of the North-East Pass, lie two islands of deeper interest than the last, though evidently of the same class. They are separated from each other by a narrow strait or creek. Their lower portions are overflowed by high tides; but their more elevated points are seven or eight feet above the mean surface of the Gulf.

The eastern, and, at present, smaller of these islands, sustains the action of the waves, which are evidently truncating it at the water level, thus creating a wide, soft beach, and a glacis or bluff bank, several feet high. In this bank, and also in the ravines of the beach, a distinct stratification is everywhere presented, with a dip, as well as I could determine, to the east, and a line of bearing from south to north. On its beach, the tide being off,

I found a feeble spring, the water of which was as strong as brine, while that of the adjoining Gulf, diluted by the river, was only brackish. *Along* with the water there was an escape of gas, and *from* it a deposit of sand and oxide of iron. The temperature of this spring, eighteen inches below the orifice, was, on the 4th of March, 1843, sixty-four degrees, Fahrenheit; that of the beach, at the same depth, fifty-six degrees; which, from the season of the year, may be taken as the winter heat of the ground at the edge of the Gulf, where the marine and river influences are blended. No fossil wood or pebbles were to be seen on this beach, or in the adjacent bank.

The other, larger and more elevated island, is, as I have said, separated from the one just described by a narrow bayou. Its structure is the same with that. Scattered over its surface, there are several salt springs, all apparently of one character. Each has a sort of orator, lined with a glazing of oxide of iron, deposited by the water as it flows out. In some of these orators the water was at rest, while it was flowing out of others. From the latter, there was an extrication of gas, but none from the former. In some obsolete fountains, there was an escape of gas without any water being visible. Around the whole, there were broad deposits of sand, which were deepest at the orators, and declined in all directions.\* This inundation of sand, analogous to a deluge of lava, by mingling with the argillaceous surface of the island, has given it a high degree of fertility. I sunk a pole sixteen feet into the largest of these orators, without meeting with any obstruction. The temperature at that depth was sixty-five degrees. By raising over this orifice a mud cone, the sides of which were thicker than the summit, water and gas were made to burst from the latter; but when the gas was conducted through the sides below, the water ceased to flow from above, although it was prevented from escaping through the lower orifice. This experiment, together with the stagnation of the water in every orator from which there was at the time no escape of gas, shows conclusively, that it is to the evolution and escape of gas we should ascribe the fountains, and to *them* the ejection of sand. The water of the spring on which the experiments were made, was noted at the time as being intensely salt;—it was, in fact, undiluted sea water. It tarnished silver when laid in the issuing current, and the gas burned with a sulphurous smell, and hence must be regarded as sulphuretted hydrogen,—the same gas that is evolved with the water of many of the 'salinas,' or brine springs of the interior of the continent.

It appears from all that has been said, that there is beneath the ultimate or Balizo Delta, a focus of gaseous evolution, and that the upward pressure of the gas, is most probably the cause of the strange insular upheavings of that quarter, some of which subside, while others, sustained below,

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\* Mr. McCullough has described the same at the South West Pass.—Documents, p. 78.

remain until washed away by the waves. On the chemical actions by which the gas is developed, I shall offer no speculation. Of the depth at which they take place, nothing, I suppose, can with certainty be determined. It may be either within or beneath the alluvial deposits. The limited area of the tuberosities, would seem to indicate the former; and still, if the gas were generated below the bed of silt, it might, perhaps, permeate it in such a manner as, at last, to produce but limited upheavings. I did not learn that earthquakes had at any time been generated by it. To the medical otiologist, the important fact is the constant escape, over the area of the lower Delta, of so great a quantity of sulphuretted hydrogen. I say great, because there is no reason to believe that the discharge is limited to the elevated spots: it probably goes on throughout the whole savanna, and the adjoining parts of the Gulf.\*

In conclusion, I must recur to the surface and productions of the last described island. The origin and character of its soil have been already indicated. The greatest difference between it and the surrounding alluvion, consists in the presence of sand in one, and its absence from the other. Both are supplied with salt and fresh water;—that of the island receiving the former from springs, the latter from the clouds; while the alluvion is, alternately, or conjointly, inundated by the river and the Gulf; hence, both are muriatic, while one is dry and the other swampy. The vegetation harmonizes with these conditions. The aquatic and sub-aquatic grasses of the swamps are absent from the island, which offers in their stead the *Myrica carolinensis*, or candleberry myrtle; the *Rubus trivialis*, or dew berry; the *Solidago sempervirens*, or golden rod; the *Salicornia herbacea*, or glass wort; and the *Salsola soda*, or salt wort—the two latter having a saline taste. Garden vegetables are also cultivated on the island by the fishermen; and peach, cherry, quince, and fig trees, planted in former times by the Spaniards, are now growing wild.

Such is an outline of the geology, topography, and hydrology of the Balize Delta. If I have introduced some things not strictly relevant to medical etiology, it was because of its singular and remarkable character; constituting it one of the most interesting of all the localities of the Great Interior Valley. In accordance with this impression, I propose to depart still further from the method pursued in describing other places, and give some account of the people and diseases of this locality.

III. INHABITANTS.—At the end of the Pass a la Loutrou, there are no inhabitants: at that of the South Pass, there is a lighthouse to warn navigators of a neighboring reef: at the termination of the South West Pass, through which all the larger vessels enter and depart, there is a lighthouse, and houses for a boarding officer, with eight or ten pilots, some of whom

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\* Although I have spoken of this as sulphuretted hydrogen, on the strength of the experiments mentioned, it may perhaps be carburetted hydrogen.



have families: at the bar of the North East Pass there is a lighthouse: all the other habitations (an occasional fisherman's hut excepted), are at, or rather, constitute —

**THE BALIZE.\***—Two or three miles above the bar of the North East Pass, a deep and tranquil bayou, resembling a broad canal, turns directly to the south, and reaches the Gulf at the distance of two miles, on either side of the two islands which have been described. On the right bank of this bayou, just below its efflux, stands the village of Balizo, in N. Lat.  $20^{\circ} 7' 15''$ , and W. Lon.  $80^{\circ} 4' 30''$ . It consists of small buildings erected on blocks, with a single narrow and serpentine street or promenade, which follows the curves of the bayou, and has an elevation of but a foot or two above its waters. At the distance of one hundred or one hundred and fifty feet from the bank on which this street meanders, is the edge of an impenetrable reed-grass swamp. Low as the bank still is, it has been raised, as have many of the little garden spots in front of the buildings, with soil from the opposite side of the bayou. The new ground beneath is, however, so soft, that the increased weight tends to sink the street; rendering new additions necessary, from time to time, to keep the street and yards dry. Occasionally, under high south-east winds, the site of the whole village is inundated. When a spot is first reclaimed and planted, it produces badly; but as the ground is stirred and the rains wash out the salt, it undergoes amelioration, and yields the ordinary garden vegetables of the south in good perfection; while the peach, and many southern flowering shrubs flourish equally well.

*Its People.*—The population of the Balizo is about two hundred and fifty; consisting almost entirely of pilots, about forty in number, with their families, a few artisans required by their vocation, a teacher, a physician, and a number of slaves. Many of them have resided on the spot for twenty or twenty-five years. A few families occupy the opposite bank of the bayou. Until within the last ten or twelve years, there were but few females; now, nearly all the pilots have wives. Thus there is a population sufficiently numerous and diversified to test the salubrity of this remarkable spot;—the legitimate object of this extended article.

My inquiries on this head were not limited to Doctor Henry Van Antwerp, the salaried physician of the Pilot's Association, who had resided there for three years and a half; nor to the late Captain Taylor, the boarding officer, who had lived at the place sixteen years; but extended to many of the pilots and their wives, on whose intelligence and respectability I could rely. In giving the results obtained, I propose, in view of the unique condition and character of this locality, not to limit myself to the diseases mentioned

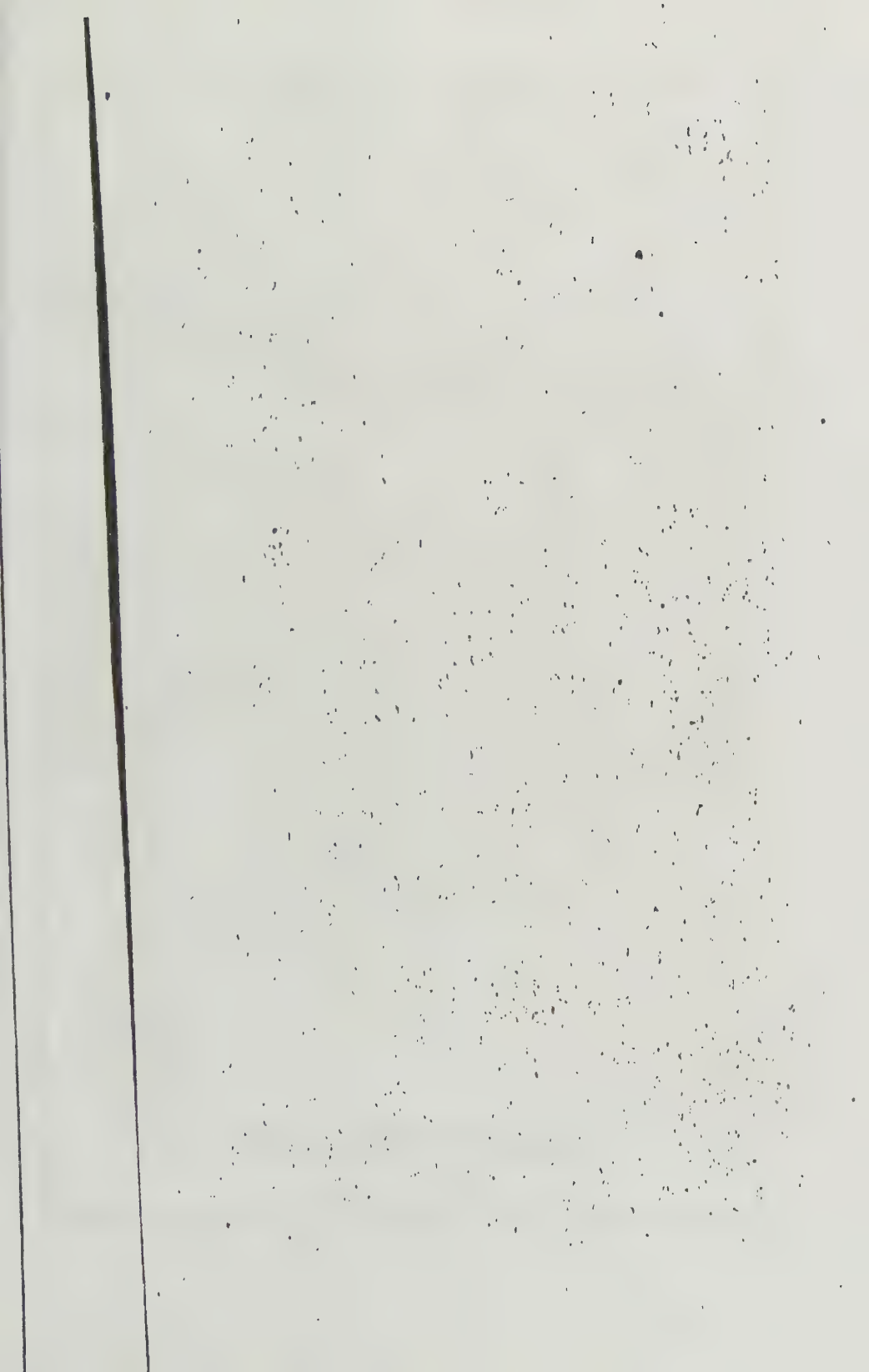
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\* Corrupted from *Valiza*, Spanish, a beacon. On this spot the first signal for indicating the entrance into the Mississippi River was erected. The present lighthouse is two miles further down the North-east Pass.

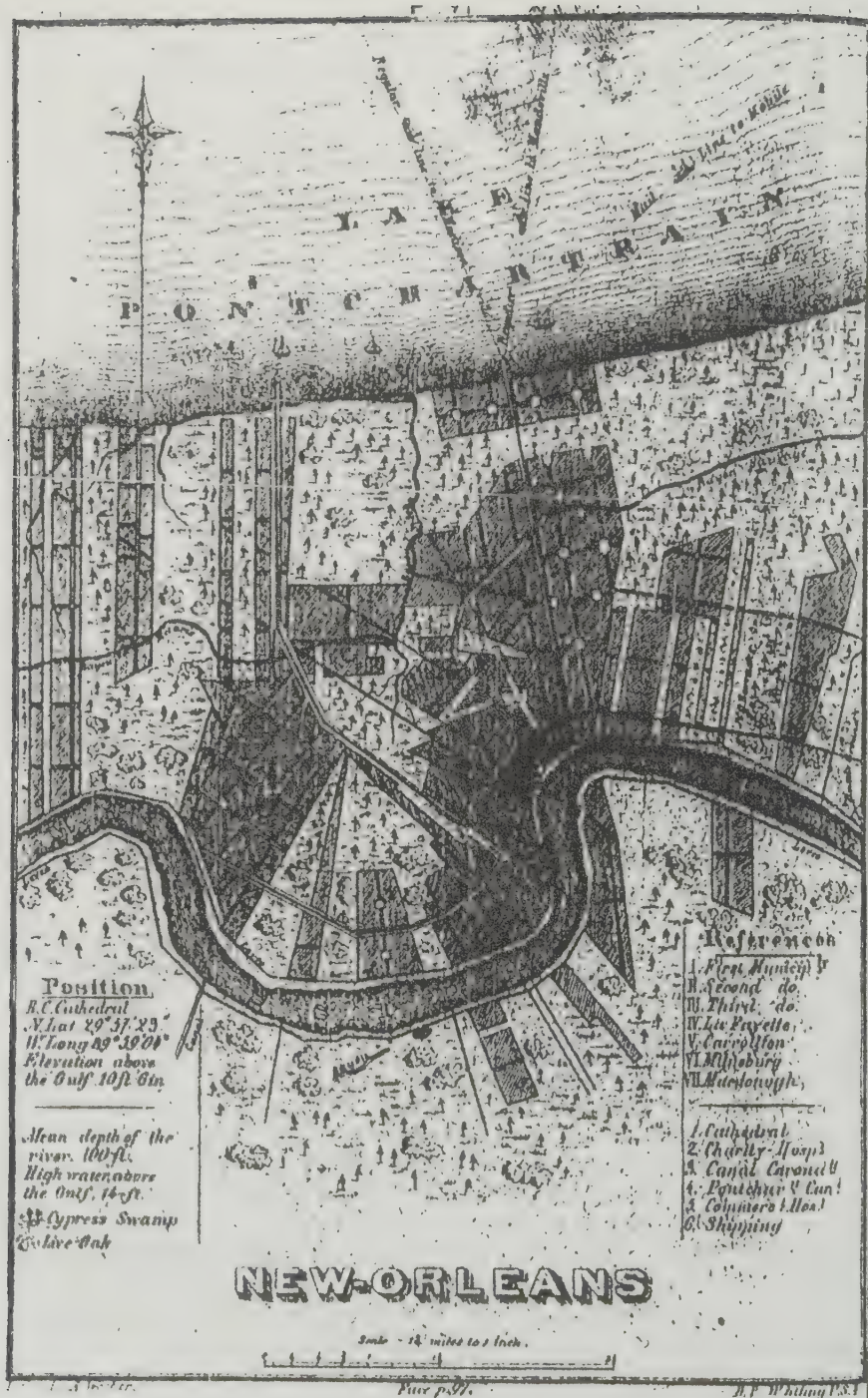
under other topographical heads; but to relate the substance of all I could collect.

*Their Modes of Living.*—Before commencing, it will be proper, however, to say a few words on the pursuits and modes of living of the people. The duties of the pilots call for great exposure, as a number of them are at all times cruising off the bar, in open boats. Formerly they were extremely intemperate, but in latter years, their habits have improved; still, the improvement is more in reference to the abuse than the use of ardent spirits. In summer a liberal quantity of claret is consumed. Tea and coffee are in general use, and the latter is frequently drunk on rising in the morning. Culinary vegetables are not abundant, and animal food is the staple of the diet of the whole population, being eaten three times a day. It consists chiefly of salted meats, fresh pork, beef, poultry, fish, and oysters.

*Their Diseases.*—The prevailing disease at the Balize, and the South West Pass, is intermittent fever, generally of the tertian type, and mild in its character, with a tendency in the patients to relapse. Doctor Van Antwerp had seen only two malignant cases. Some immigrants have lived there several years before they sickened. Mrs. Anderson, who had resided there longer than any other individual, thought the disease much less frequent than formerly. Doctor Van Antwerp had noticed a considerable number of diseased spleens, but very little neuralgia or dropy, consequent on the fever. Remittents appear to be decidedly rare, and the same is true of yellow fever, notwithstanding almost every vessel from Havana and Vera Cruz enters through this Pass, and is visited by the pilot and boarding officer. Doctor Van Antwerp arrived in October, 1830, when the fever was extensively prevalent around the shores of the Gulf, including, of course, New Orleans; and in 1841 and 1842, it was prevalent in that city and some other places; still he had seen only four cases; one of which occurred in a person from New Orleans; two others seemed to have originated in the village, and the fourth occurred in an oysterman, who declared he had not been at New Orleans. These cases occurred in different years. Eruptive fevers are exceedingly uncommon, and chronic cutaneous disorders seldom show themselves. The itch is said to lose its contagiousness, and at length cease. The summer gastro-intestinal affections, such as cholera morbus, cholera infantum, and dysentery, especially the two former, are unfrequent. Pulmonary inflammations of all kinds are quite as uncommon. Doctor Van Antwerp was induced to remove from the state of New York to the Balize, on account of his liability to pulmonary catarrh, which his residence at the latter place has nearly removed. Croup is almost unknown. Of nervous diseases, convulsions of children are more frequent than all the rest. Doctor Van Antwerp had seen nine cases, five of which proved fatal. The number of children among whom they occurred, was about forty—the time, three and a half years. The children who suffered, were not, as it is termed in the nursery, “within the month.” Another disease of frequent occurrence is rheuma-







### Position

R.C. Cathedral  
 N. Lat  $29^{\circ} 31' 29''$   
 W. Long  $89^{\circ} 39' 00''$   
 Elevation above  
 the Gulf, 10 ft. 6 in.

Mean depth of the  
 river, 100 ft.  
 High water above  
 the Gulf, 14 ft.

Cypress Swamp  
 Calve Cah

### Reference

1. First Municipality  
 2. Second do.  
 3. Third do.  
 4. La Fayette  
 5. Carrollton  
 6. Metairie  
 7. Chalmette

1. Cathedral  
 2. Charity Hospital  
 3. Canal Carondelet  
 4. Poydras & Canal  
 5. Common Market  
 6. Shipping

## NEW-ORLEANS

Scale - 14 miles to 1 inch.

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tism, which is generally subacute or chronic, and falls especially on the pilots who are greatly exposed. Consumption is said to be rare. Captain Taylor, who had resided there sixteen years, could recollect but three cases, and the patients had all arrived there with the disease in its forming stage. Nevertheless, his wife, who many years before had left the state of New York, was evidently falling into that disease, and two of his children, born at the Balizo, had strumous swellings and abscesses of the neck.

The negroes of the Balizo are fed on nearly the same food with the whites, but lodged in damper situations near the ground; nevertheless, they enjoy still better health than their masters. Almost their only disease is mild intermittent fever, to which, moreover, they are less liable than the whites. They average fifty in number, and during three and a half years there had been but two deaths.

It results from this rapid sketch, that no new disease has been developed in this locality; that several appear to be less prevalent here than in the interior; and that autumnal fever is not as malignant as we find it in many extensive districts of country several degrees further north.

### SECTION III.

#### NEW ORLEANS.

I. POSITION AND PLAN.—The City of New Orleans (*Pl. VI*) stands on the left bank of the Mississippi River, in N. Lat.  $20^{\circ} 57' 23''$ , and W. Lon.  $89^{\circ} 59' 4''$ . \* After having, from its sources, pursued nearly a south course, the river, as we have seen, while traversing the Delta, turns to the east, and then to the south-east, until it reaches the Gulf. It is thus brought near, and parallel to, the southern coast of Lake Pontchartrain, so as to form a kind of Isthmus, formerly called the Island of Orleans; which at the narrowest point is not more than five miles in width. When opposite the middle of that lake it makes a horse-shoe bend by the south, and then flows off in its general course. Around the lower part of this bend, on the left bank, we have the site of the City.

By examining its plan (*Pl. VI*) it will be seen that, the center consists of the old or original town, having the form of a parallelogram; one end of which rests upon the river, while its sides, and the streets parallel to them, stretch from the bank in a northern direction. This portion is now called the *First Municipality*. Immediately below, the river having a south-easterly direction, lies that extension of the old town, which now constitutes the *Third Municipality*, the streets in which run from the river, to the north, and north north-east. Above the original town, and consequently within the horse-

\* It will be convenient, and cannot lead to any practical error in a work of this kind to speak of this city as having the latitude of thirty, and longitude of ninety degrees.



shoe bend, is the *Second Municipality*, with streets running north-west, from the river. Adjoining this Municipality, on the south-west, and near the bottom of the horse-shoe bend, is the faubourg or city of *La Fayette*; above which, on the river bank, are two or three *projected* villages; after which, as we rise out of the concavity, to the north-west, we come to the town of *Carrolton*; the streets of which run north north-east. Thus the line of coast, from the western limit of *Carrolton* to the eastern boundary of the Third Municipality, is at least twelve miles; and public or private enterprise, in anticipation of the future, has already sought to give the great commercial metropolis of the *Mexican or Southern Basin*, that extension. This, however, will appear the less remarkable, when we recollect, that the spread of the city back from the river cannot be effected without great labor and expense. At present, a line of three miles, the center of which shall be the adjacent angles of the First and Second Municipalities, will cover those portions of the city which are of most interest to the physician.

The right bank of the river, is not without its attempted towns. Opposite *La Fayette*, are *Cosmopolite* and *Gretna*; across the river from the First and Second Municipalities, lies *MacDonoughville*; and facing the Third Municipality, stands *Algiers*; all of which are but inconsiderable places.

From the dome of the *St. Charles Hotel*, standing near the center of the city, the periscope presents many germinal villages, which suggest to the mind a true idea of the vast relations of this spot with the interior; the inhabitants of which, in augmenting numbers, must forever continue to visit *New Orleans*, and thus maintain the interest of the medical profession, in all that relates to its diseases.

**II. LAKES AND SWAMPS.**—Directly north of the city, at the rectilinear distance of seven miles from the bottom of the horse-shoe bend, and about four and a half from each of its extremities, lies the southern coast of *Lake Pontchartrain*. To the east, at the distance of twenty miles, is the coast of *Lake Borgne*. At the same distance, to the south-east, is the small *Lake Lery*; at double the distance, *Chandeleur Bay*. On the opposite side of the river, to the south-west and south, are *Des Allomands*, *Ouacha*, *Potito*, *Hermitage*, and *Rondo Lakes*, with *Barataria* and *Bastion Bays*, varying in distance by straight lines from ten to thirty or forty miles from the city.

Thus *New Orleans* is nearly surrounded by lakes and bays; to the west only are they absent; and there the river in some degree supplies their place, by meandering from west to east for seventy or eighty miles. Even this, however, presents an inadequate idea of the extent of watery surface; for in every direction from the city, unless when we travel on the 'coast,' or river bank, we encounter cypress swamps, terminating, either at the shores of a lake, or in grassy savannas too wet to be traveled over. Before levees were raised upon the banks, the whole region was annually overflowed; but during nine months of the year, a strip on each side, varying from a few yards to a mile in width, was dry on the surface, yet abounded in water



underneath. At New Orleans, as everywhere along the lower Mississippi, this strip was highest next the river, and not only the overflowings of the stream when swollen, but the rains, took a direction from the river, and replenished the swamps and smaller lakes. The elevation of the bank on which the city stands was but a few feet above the surface of Lake Pontchartrain, and Lake Borgne.

III. *BAYOUS*.—These lakes are, and must forever remain, the reservoirs into which the swamps around New Orleans discharge their superfluous waters. The draining is effected by natural canals or bayous, which I proceed to enumerate.

1. To the north-west of the city, there are two or three, which run from the swamp into Lake Pontchartrain; one of which is called *Bayou Chapitoulas*. They do not exert much, if any, influence on the city.

2. *Bayou Metairie*.—Further west, and nearly equidistant between the sources of these bayous and the river bank, is the beginning of the Bayou Metairie. Its course is eastward, until it joins the larger bayou, to be mentioned next. The Metairie is cut by the new ship canal from Pontchartrain to Julia street, in the Second Municipality, and now, of course, discharges its waters into that trough. Along this bayou, there is considerable reclaimed land, and a good road.

3. *The Bayou St. John*.—Of all the bayous between the left bank of the river and the lakes, this confers on the city the most important benefits. Originating, by several branches, in the Second Municipality, about two miles from the river, it traverses the First Municipality, and thence makes its way directly north, to Pontchartrain. Its waters, of course, flow with a feeble current, but are deep enough for sloop navigation.

4. *Bayou Sauvage or Gentilly*.—Its origin is near the dividing line between the First and Third Municipalities, about two miles from the river. At first, its course is nearly north, but it bends to the north-east, and finally discharges its waters into the Pass called Chef Montour, one of the connecting straits between Pontchartrain and Borgne. Along this bayou, there is also a road, and borders of arable land.

5. *Bayou Bienvenue*, which originates in the eastern part of the Third Municipality and flows to the east.

6. *Bayou Mazumt*.—It rises a little further down the river, and flows nearly in the same direction.

7. *Bayou Morcier*, which begins still further down, and runs to the north-east.

The last three bayous unite, and under the common name of Mazumt, flow into Lake Borgne.

Thus we see that the declivity between the left bank of the river and the lakes, has numerous swamp-bayous or natural canals, which constitute the basis of a hydraulic system, by which a large portion, if not the whole tract, might, by human labor properly directed, be drained and dried.

IV. **DIKES.**—But, without ditching, nothing of substantial value can be accomplished; for, although the fall from the river to the lakes is about twelve feet, much of it is near the former, and the declivity gets less and less as we recede from the river. Hence the water, after it has sunk to a certain level, will not flow off from the swamp, without receiving an impulse from the hand of art. When intersecting or confluent ditches are dug, and a common trunk is made to open into one of the bayous, the water gradually drains into it; not only off, but from beneath, the surface, down to the level of that which is in the ditches. In this manner the waters of the swamps are collected into the dikes which are dug through them; but the inclination is too little to impart much current, and hence, to the full effect of emptying the marshes, it has been found necessary to establish a current from their ditches into the bayous. This is done by the paddle-wheels already described in speaking of the Delta generally. The only bayou, however, into which the waters have yet been driven, is St. Johns.

V. **CANALS.**—In 1776, Baron de Carondelet, Spanish Governor of Louisiana, finished the sloop canal, which still bears his name. Its length is a mile and a half. One end terminates in the Bayou St. John; the other, within half a mile of the river, where there is a basin; which was dug in what had, up to the time of its excavation, in 1700, been a public cemetery. The whole is within the old city, now called the First Municipality. According to Dr. Thomas,\* the yellow fever which occurred in the autumn of that year, was the first which had visited the city; but I have learned from one of the oldest and most respectable Anglo-American citizens, Richard Relph, Esq., that it occurred, he himself being a patient, in 1701. The effect of this canal was to promote the drying of that part of the swamp through which it passed.

The *New Orleans Canal* was excavated many years afterwards. It extends from a basin at the end of Julia Street, in the Second Municipality, to Lake Pontchartrain, a distance, following its banks, of nearly six miles. The excavation of this canal through a cypress swamp, was at the expence, as I have been assured by Dr. Meux and Dr. Barton, of several hundred lives. The work was continued through summer and autumn, and the laborers were chiefly immigrant Irishmen. They did not, however, perish of yellow fever, but of intermittents and remittents. As the water in this canal, is on a level with that of Lake Pontchartrain, ditches for draining the back part of the Municipality, and, indeed, the whole swamp between it and the lake, may be conducted into it.

VI. **STREET CURRENTS.**—The rains that fall on the city plat, which inclines from the river, must, of course, take the direction of the swamps. As far as the gutters are paved, the water flows with sufficient velocity to carry

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\* *Essai sur la Fièvre Jaune D'Amérique.* 1823, p. 70.

forward much of the filth thrown in them; but where they are unpaved, most of it is left behind, the superincumbent water slowly draining off, and leaving semi-fluid deposits of mud. Many of the cross streets, moreover, have so little fall, that their gutters, except immediately after copious rains, present a very foul aspect. For several months in the year, however,—that is, from winter to midsummer,—the gutters of every street running from the river, might be washed out by a lively stream; for, throughout that period, the river is high enough to discharge its waters into them through depressions or tunnels in the levee. In the old city, now First Municipality, many of the gutters are subjected to this purification; and the whole should be brought under the same influence. With such a hydraulic system, the city might have its filth successfully transported to the swamp, or even to the bayous and canals which open into the lake, which would be much better.

VII. INUNDATIONS.—To whatever extent a system of ditching may be carried, the isthmus between the city and the lakes will forever remain liable to occasional inundations.

1st. Heavy rains, when they happen to coincide with a defective or suspended action of the machinery which propels the water from the main dike into the bayou, will occasion partial inundations: an instance of which I witnessed in the spring of 1846, when riding through the northern part of the First Municipality, with Dr. Meux.

2d. A crevice in the levee above the city, at any point below Bayou Manchac, may produce a much more extended inundation; such as occurred in the year 1816. As the water, which was three or four feet deep, drained off rapidly into the lakes, it was supposed to carry with it a great deal of filth, and seemed to have had a salutary effect on the health of the city.\*

3d. Under strong winds from the north and north-east, the waters of Lake Pontchartrain may be thrown into the swamp to the depth of several feet, and even come into the thickly settled parts of the city; an event which has happened more than once. Against this kind of deluge, there can be no protection; and it should not, perhaps, in reference to the health of the city, be regretted; as it occurs upon a surface, which, under any degree of ditching, is likely to remain inordinately moist; and the recession of the water can scarcely fail to carry off a large amount of filth.

VIII. FORESTS.—To practice ditching, it is necessary to destroy the forests which overshadow the swamp; but this should not be done until the ditching can be commenced; as an exposure of the surface to the rays of the sun, must, of necessity, quicken the decomposition of organic matter.

IX. FEVERS OF THE SWAMP.—The inhabitants of the suburbs of the city, who live adjacent to, or within, the swamp, but seldom affected by

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\* Rapport Publié au nom de la Société Médicale de la Nouvelle Orléans, Sur la Fièvre Jaune, 1819, p. 50.



yellow fever, are liable to intermittent and remittent fever; but cases of great malignity are not particularly common. These fevers sometimes reach the center of the city, but such invasions are not annual.

We must now transfer ourselves from the swamp, to the river side of the city.

X. **THE BATTURE.**—For a great length of time, the Mississippi, during its annual floods, has been depositing silt in front of the city; thus raising and widening its bank in the direction of the opposite side. This new alluvial formation has received the name of Batture. The efficient cause of its deposition, is an eddy, or counter current, which exists from some point in the Third, to a point in the Second Municipality, and the momentum of which is sufficient to turn the sterns of steamboats which lie at the wharves *up stream*—that is, in the opposite direction from that in which the general current of the river would place them. As long as the cause of this eddy continues, the growth of the Batture will, of course, go on, and be accompanied, as it is, with some encroachment of the river on the opposite bank. Large portions of the new alluvial plain have been built upon, but a wide margin remains uncovered with houses, and presents the appearance of a common, which even the mighty commerce of the interior, can but partially overspread with the products of the soil. Portions of the outer edge have been raised, by art, above high water mark; while others are covered with planks supported by props, constituting docks, which are extended so far out that steamboats can lie at their terminations.

XI. **CITY FILTH ALONG THE RIVER.**—The streets adjacent to the river for three miles, are compactly built up, and from the dwelling houses, taverns, drinking houses, warehouses, market-houses, oyster-sheds, sugar-wharves, and cotton-presses, a vast quantity of filth, and organic recrements, find their way into the water's edge; and although a portion may be wafted off, much is deposited on the subaqueous batture, and, with the fall of the river, subjected to solar influence. \* In three visits to New Orleans, I ascertained, by personal inspection, that the condition of things described by Dr. Plecornell, in 1823, still continued without much abatement, twenty years afterwards. Within that time, the police had, it is true, been greatly improved; but the population had also greatly increased, with an inevitable augmentation of foul and corrupting offals.

XII. **BOATS AND SHIPPING.**—The last head gives a very inadequate idea of the amount of filth thrown into the river opposite the city. Its commerce during six months of the year, is too great to be estimated by those who have not seen it. Three classes of vessels carry it on—flat boats, or arks, steamboats, and ships.

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\* Des Considérations Hygiéniques sur la Nouvelle Orleans. By J. M. Plecornell, p. 19, 1823.—Essay on the subject of Quarantine Laws. By W. P. Hort, M. D., New Orleans Medical Journal, Vol. II, p. 1.

The first lie chiefly opposite La Fayette, and further up the river to Carleton. Their number is immense, and various kinds of filth, with damaged cargoes, are thrown from them, into the very margin of the river, whence they are but partially floated off. When the boats are sold, and those who descended the river have left them, they often lie, for a long time, attached to the bank, or half sunken, and contain accumulations of foul and putrifying matters exposed to the rays of the summer's sun.

The steam boats lie chiefly in front of the center of the city, divided between the adjacent portions of the First and Second Municipalities. Their freight is cotton, sugar, and produce and provisions of all sorts. The number of persons on board of each, while lying at the wharf, cannot be less than fifty; and the laborers occupied near the water's edge, might be counted by thousands. Thus the amount of filth and foulness which falls upon this part of the batture, during spring and the early part of summer, is very great.

The ships, not anchored in the stream, but attached to the docks, are found in two different places, in front of the Second and Third Municipalities—the steamers intervening. Nearly every ship, in reaching the port of New Orleans, has sailed within or very near the tropics, and arrives, of course, with its hold in a filthy state. The work of debarkation and purification is conducted where they lie; and consequently, they contribute a full proportion to the foul accumulations over which they ride.\*

From the various sources which have been indicated, after making ample allowance for what is floated off by the current, there must be annually deposited with the river silt, upon the sloping margin of the Batture, for three miles in front of the city, a deep and foul stratum of organic decompositions; which, on the subsidence of the river, from July to November, is exposed to the burning sun of the thirtieth degree of latitude. If there be any gases, noxious or innoxious, developed during that period, a portion of them may be absorbed by the river, but the greater part must be wafted into the city; for the prevailing winds are between south-east and south-west.

XIII. FEVERS OF THE RIVER SIDE.—For the purpose of comparing this side of the city with that adjacent to the swamps, I will remark, that this is the locality of yellow fever, as the other is of autumnal intermittent, and remittent. The latter, however, occur here also; but many of the cases are in persons from the interior, who arrive with the semina of the fevers in their systems and become patients, either in the boats which bring them down, or in the watermen's boarding houses.

XIV. CONDITION OF THE CITY.—The streets in general are of moderate width; a few are broad, but a greater number narrow, using those terms as one familiar with the towns of the interior is likely to employ them. For a long period of time but few of them were paved; latterly, however, that important improvement has been advancing with commendable rapidity. The stones

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\* Dr. Hort.

are brought from the Eastern States and Europe, as ballast, by ships engaged in the cotton trade.

The squares are generally small, and consequently their central parts are much covered over with back buildings. The houses are very unequal and unlike each other; the old French and Spanish domicils being mostly of wood, one or two stories high, and faced or surrounded with verandahs. In the old or First Municipality, there are, however, many three story brick, as in the American or Second Municipality there are many frame houses, built after the fashions which prevail in the interior. Arrangements for warming and drying are, in many houses, defective and inadequate; and the invalid from the upper country, who may have been accustomed to lodge in dry and warm rooms, will probably find himself placed, in winter and early spring, in a chamber which, to his feelings, will prove both cool and damp. The diet of the inhabitants approaches too near to that of the people of the United States generally, to justify the opinion, that any peculiarity of constitution or diseases which may exist, depends upon it. Vegetables of various kinds are abundant; and if butcher's meat is less used, the animal element is made up by fish, eggs, bacon, and oysters. Coffee is in universal use, and taken by multitudes before breakfast. Claret is drunk copiously, and generally throughout most of the year; but ardent spirits are likewise used with great liberality. Formerly, well-water, the composition of which has been already given, was extensively used; but since the year 1886, there has been a liberal supply of river-water, pumped up from a point above the ship and steamboat wharves, into a reservoir with partitions, so that the deposit of sediment is going on in some, while the water is flowing off from other compartments.

XV. COMPOSITION OF SOCIETY.—The settlement of New Orleans was begun by the French in the year 1718. From the beginning, African slaves made a part of the population. Settlements were soon made both above and below the town. Five years after its foundations were laid, a company of Germans, who had left Europe for the purpose of settling on the Arkansas, were disappointed in their object, and established themselves on what was therefore called the German coast, from thirty to forty miles above the town, whence many of their descendants became mingled with its population. Meanwhile, immigrants from France continued to arrive, and while a portion remained in New Orleans, others settled on the coast above and below the town; and on the banks of the Bayous La Fourche and Tche. In 1764, a body of French from Nova Scotia, then called Acadia, having lost that province in consequence of its conquest by England, migrated to Louisiana, and settled partly in New Orleans, but chiefly on that part of the river bank above the German settlement, which has since been called the Acadian coast. In 1763, Louisiana was ceded by France to Spain, but the latter did not obtain possession until 1769, fifty-one years after the settlement of New Orleans. An immigration of Spaniards now took place, but not, I think, to



such an amount as materially to affect the composition of society. The Spanish domination continued thirty-two years, and terminated by a restoration of the colony to France. Two years afterward, it was sold to the United States, and possession taken on the 30th of November, 1803. Up to that time, there had been but little Anglo-American immigration, and the population did not much exceed eight thousand. Since the transfer, forty-five years have elapsed, and the permanent population has risen, including transient persons, to more than one hundred and thirty thousand. This rapid increase has been chiefly from the United States; but England and Ireland have contributed a liberal number.

From this narrative we see, that the white population of the city consists of mixed masses of French, Spaniards, Americans, Irish, and Germans, with stragglers from England, Scotland, and Italy. There have been many intermarriages, but still the distinctive physiological characters, especially of the French and Americans, are well maintained. The Creoles are the natives, of French or Spanish parents. The negroes make a larger element of the population than either of the sub-varieties which have been mentioned; especially when we include with them the mixed races; which, under the name of mulattoes, quadroons, and griffes, are exceedingly numerous.

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## SECTION IV.

### SMALLER TOWNS WITHIN THE DELTA.

I. MILNEBURG.—I do not know that even the people of this place are familiar with its name, which I copy from Springbatt and Pille's excellent map of New Orleans and its environs. It designates the port and village on Lake Pontchartrain (*Pl. VI*), where the railroad from the Third Municipality of New Orleans terminates, at the distance of six miles from the Mississippi River. In crossing the isthmus on that road, we see, that the whole was once a cypress swamp, though much of it has been reclaimed by cutting down the forest and ditching the ground. Still, for two miles before reaching the lake, the road lies through a swamp, which imperceptibly graduates into the lake. Thus there is, or rather was, a broad margin of cypress forest, on which even the low tides of the lake ebbed and flowed, and over which the winds from the north or north-east, impel its waters. The lake is literally without any restraining banks, and its margin is so shallow, that a long wooden dock is necessary for communication with the sloops and steamers which frequent the port. The houses of the village are generally built on blocks, or earthen foundations, which have been thrown up to raise them above the waves. On this broad tidal bench, remote from any deep water, every kind of impurity is but rolled backward and forward; and taking the locality as a whole, it may be said to abound in filth, while a dark swamp lies immediately in its rear.

Of the prevalence of autumnal fever at this locality, compared with other places in the Delta, I am not informed. It has been affected with yellow fever; and it is in reference to the history of that disease that an account of its topography becomes necessary.

II. FRANKLIN.—The Têche (*Pl. V*), one of the most beautiful bayous of the Delta, and the principal river of the ATTAKAPAS COUNTRY, has on its banks three small towns, which require to be mentioned. The lowest is Franklin, on the right bank of the bayou, in N. Lat.  $20^{\circ} 45'$ , at the head of low water steamboat navigation. Its population is four or five hundred. Its site, which rises above the highest freshets of the bayou, has in its rear the usual cypress swamps. Autumnal fever, as I learned from Doctor Hornsby, now of Plaquemine, occurs every autumn, both in the village and on the banks of the bayou above and below; but in general without any extraordinary violence. Yellow fever has invaded it, once or oftener.

III. NEW INERTIA is situated higher up the Têche (*Pl. V*), on the same side with Franklin, at the very margin of the Delta. It stands, in fact, on the extreme margin of the high plains of Opelousas, about twenty feet above the surface of the bayou.\* Its latitude is  $80^{\circ}$  N. Like Franklin, it is subject to autumnal fever, and has also been reached by yellow fever, when that disease was epidemic in New Orleans.

IV. ST. MARTINSVILLE (*Pl. V*), is the highest town up the Têche, being in Lat.  $30^{\circ} 10'$  N. Its site is on the right bank, and is too elevated to be overflowed by the greatest floods of the bayou; but so level, that the rains do not drain off, and the surface becomes extremely soft in wet weather † At a distance from the bayou, there are the usual cypress swamps. St. Martinsville, like the towns below, is subject to mild, endemic, autumnal fever, and has likewise experienced visitations of yellow fever.

V. THIBODEAUX.—We pass from the Têche to the Bayou La Fourche, which leaves the Mississippi on the right hand side, one hundred and eighty-four miles from the Gulf of Mexico. The highly cultivated borders of the La Fourche, protected by levees, are limited in the rear by swamps. On one of these belts, about forty miles down the bayou, stands the village of Thibodaux, which in its medical topography presents nothing peculiar, and would not demand a notice, but that it has suffered one or more invasions of yellow fever.

VI. DONALDSONVILLE.—This beautiful and comparatively new town, is built on the right bank of the Mississippi, in N. Lat.  $80^{\circ}$ , immediately below the efflux of the bayou which has just been described. Its site is more elevated than many others within the Delta, and does not, therefore, suffer inundation from any but the greatest floods of the Mississippi. In cleanliness, as well as dryness, it may be ranked with the best localities of the

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\* Darby: Emigrant's Guide.

† Ibid.

Delta; and the swamp in its rear, to the south, does not approach it as closely as the same kind of surface approaches New Orleans, and many other towns of this region. Autumnal fever prevails here, as in the surrounding localities, and sometimes assumes a malignant type. Yellow fever has made it a few visitations, but none were of a violent character.

VII. **PLAQUEMINE** is a respectable and well-built town, of the smaller size, situated thirty-five miles above Donaldsonville, on the right side of the Mississippi, immediately below the efflux of Bayou Plaquemine. Its site is dry, but the bayou winds closely round it, and there are, of course, cypress swamps in its rear. It suffers moderately from autumnal fever, and has experienced a few, but not very serious, invasions of yellow fever.

VIII. **ANGLE OF THE DELTA.**—This extends from the Bayou Plaquemine to the mouth of Red River, a distance of more than one hundred miles, and includes the important parishes of West Baton Rouge, Point Coupée, and the eastern part of Avoyelles, all in the state of Louisiana. The Mississippi, through nearly the whole length of this angle, flows close to its left bank, which is a continued tertiary bluff. The right bank is raised by a levee, which, however, does not afford full protection from overflows; for the bonds in the river are here of the most remarkable kind; and consequently, from the retardation of the current, the levees are apt to give way; moreover, the banks of the Bayou Atchafalaya, which flows through the western part of the angle, are so low, that in the annual rise of the Mississippi they are deeply overflowed. Thus the settlements in this bottom are chiefly on the river bank, with a levee in front, and swamps, which generally dry up in autumn, and bayous, ponds, and lakes, in the rear. This portion of the Delta was settled by the French at an early period; and all the arable land has long been subjected to the action of the plow, and other agricultural implements, with full exposure to the rain and sun. Cotton, the former staple, has largely given place to sugar. The population of this region is entirely rural. There is not, I believe, a single town; but at the distance of fifty-five miles above Plaquemine, there is a public steamboat landing called Waterloo.

From all that I have been able to learn, autumnal fever in this portion of the Delta is generally mild and not remarkably prevalent. Doctor Thomas Beaumont, who resided, when I saw him, on the tertiary plateau, several miles from the Delta, in the parish of East Baton Rouge, assured me, that malignant cases of autumnal fever were decidedly more frequent and fatal where he then lived, than in the Delta from which he had removed; and Doctor McKelvey, of St. Francisville, informed me on the authority of Doctor G. W. Smith, who had practiced his profession on the Point Coupée coast, and also on the opposite bluffs in West Feliciana, that the fevers of autumn were milder in the former than in the latter locality. We must now ascend to the bluffs.



## SECTION V.

## TOWNS ON THE BLUFFS OF THE DELTA.

Every locality described in the preceding Sections of this Chapter, lies *within* the Delta, has an alluvial surface, and rises but a few feet above the river. Having traveled over the whole of that peculiar region, we must now ascend to the towns which have been built upon its bluffs, beginning with its right hand, or south-western side. The bank or bluff which constitutes the boundary of the upper part of the Delta in that direction, rises thirty or forty feet above the river and its bayous; and stretching off as a plain, on which there are many extensive prairies, constitutes the OPELOUSAS COUNTRY. I am informed by Professor Forshey, of Vidalia, that this plain is a bed of diluvium or drift, having in its rear a higher tertiary formation, covered with pine forest.

I. OPELOUSAS.—The position of this town, and its distance, (about five miles), from the navigable bayous of the Delta, may be seen in *Pl. V.* In the absence of any later description, I shall transcribe from Darby, \* the following topographical notice:

"The neighborhood of Opelousas church is a kind of table land, from which the waters flow as from a common center. Without reference to a good map, it is very difficult to explain the very complicated structure of this country. The water-courses are interwoven into each other, with an intricacy that demands much attention to comprehend with precision. Three miles north-west of Opelousas church, there is, surrounded by prairie, a body of woods two miles long, and a half a mile wide. This isolated forest is not unaptly called *Isle au L'Anglais*. The denomination of island is not unappropriate when applied to a copse standing in a sea of grass.

"From the east side of this island, flow the head waters of the Mermentau. The source of the river is an extensive, low, wet plain. The water gradually collects into a single channel, which passes to the southward, within less than a mile of Opelousas church; and continuing that course about three miles, divides; one part running eastward into Bayou Bourbé, contributes to form the Vermillion; the other runs south-west, into Bayou Plaquemine Brulé, and finally into the Mermentau River.

"Three miles north of Opelousas court-house, the drains of the prairie are connected; part of the water flows north, into Bayou Grand Louis, and the other, south, forming the head of Bayou Bourbé."

Of the prevalence of autumnal fever at Opelousas, I cannot speak with any certainty, and have been led to introduce a notice of its topography, because it has suffered from yellow fever.

II. BATON ROUGE.—That portion of the Delta which lies above Bayou Plaquemine, on the west, and Bayou Iberville or Manchac, on the east, has

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\* *Emigrant's Guide*, 1818.

been already designated as its angle. The plains of Opelousas, as we have just seen, constitute its boundary in the former direction; in the latter it is terminated by the tertiary formation, which stretches westwardly from Mobile Bay, and reaches the Delta, a short distance above the Bayou Iberville, not far below Baton Rouge. It is common to speak of the site of this town as the first high land, on which the eye rests in ascending the Mississippi; which here, instead of keeping out in the middle of the Delta, presses hard upon the bluffs. When the observer, standing upon the bluffs, looks off to the west, he sees, on the opposite side of the river, a low, wet, and level bottom, with its levee, and belt of cultivated ground graduating into cypress swamps, which extend, with the interruptions occasioned by the Atchafalaya and other streams of the Delta, quite across to the terrace of Opelousas. From this broad paludal surface, every westerly wind transports to the bluffs whatever exhalations may arise. But we must fix our attention upon the town.

Baton Rouge, standing on the bluff which has been described, in N. Lat.  $30^{\circ} 36'$  and W. Lon.  $91^{\circ} 33'$ , is distant from New Orleans one hundred and forty miles—from the Balize two hundred and forty-four. The elevation of its site is about twenty-two feet above high water-mark of the river; but such is the close approximation of the land and water surfaces to the same level throughout the Delta, that he who has sojourned upon it for awhile, will, on approaching this bluff, regard it as much higher than it really is. \* The town plat is free from ponds and marshes; but I observed, in a short excursion on the plain behind it, that the rain water does not readily sink into the ground, and is retained on the surface by its levelness. To the south, down the river, there is a narrow, cultivated bottom, some portions of which are overflowed in times of high water. To the north, and adjoining the town, there is a small tributary, up which the waters of the Mississippi are backed, when the river is high; but Doctor R. F. Harney, U. S. A., assured me, that the silt then deposited is washed away, by the copious rains which, in summer, follow on the subsidence of the freshet. Up the river, the nearest swamp is fifteen miles. †

When visiting Baton Rouge, in 1844, I was informed by Doctor French, who had resided there more than thirty years, and also by Doctor Harney, who had been stationed there for the greater part of a quarter of a century, that, in reference to intermittent and remittent fever, Baton Rouge cannot be regarded as unhealthy; and, as far as the people of the town are con-

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\* I have been told, that horses reared in the lower part of the Delta, and always accustomed to a level surface, have shown great awkwardness and some difficulty, in attempting to ascend the bluffs, when brought to them, as they occasionally have been; a fact which strongly illustrates the flatness of that surface, and one of its physiological effects.

† *Med. Stat. U. S. A.* p. 253.

cerned, I know of no facts which contradict their assertions. It has several times, however, been visited by yellow fever.

*Military Post.*—In the year 1810, the Government began the erection of barracks on the bluff, adjoining and above the town, and for the first six years, the soldiery suffered more from sickness than at any other post in the United States; which, of course, was charged upon the local situation. Doctor Harney, however, ascribes their sickness and mortality to the following causes: *First.* They were recruits from the north. *Second.* They were extremely intemperate. *Third.* For the purpose of building barracks, they were obliged to fell trees in a cypress swamp, fifteen miles above the town; in doing which they were greatly exposed to the direct action of the sun and rains.\* In latter years, as Doctor Harney assured me, the soldiers are much healthier. The army returns, for seven years, between 1820 and 1839, give for intermittent fever a ratio of fifty-one per cent., and for remittents of thirty per cent. These ratios, Doctor Morry, the editor, remarks, are not beyond those of some other posts, but the proportion of fatal cases was greater than at any other; the remittents often assuming a most malignant type.

Baton Rouge was settled almost as far back as New Orleans; and until the cession of Louisiana to the United States, in 1803, its population was chiefly French and Spanish. Soon afterward, emigrants from the United States began to flock thither, and to other places in that region; but Spain kept possession of the whole until 1810, alleging that it was a part of West Florida.† At present, although it has a mixed population, the American greatly predominates over all the rest. The town, as we have seen, is the site of a permanent military post; the penitentiary of the state has been erected here; and lately the legislature of Louisiana has fixed upon it as the future capital of the state. Thus, although not a commercial town, its military, civil, and political importance, entitles it to the attention of the medical historian.

III. PORT HUDSON.—This inconsiderable village, with a population of eighty or one hundred, situated twenty-five miles above Baton Rouge, is a landing place for East Feliciana and other parishes of that part of Louisiana. From Doctor Beaumont I have learned, that it stands on a high bluff, at the foot of which the river flows. Just above the village, there is an extensive swamp between the bluff and river, and below some smaller swamps and ponds. It experiences an annual visitation of autumnal fever, like other places in the South; but the chief reason for introducing a notice of it here, is, that it has repeatedly suffered from yellow fever.

IV. BAYOU SARA, AND ST. FRANCISVILLE.—These adjoining towns are

\* Medical Statistics, U. S. A.

† Pitkin's Stat. Views of the United States, p. 17.



situated ten miles above Port Hudson, in the parish of West Feliciana. The former stands on a bottom of moderate width; the latter, immediately behind it, on a tertiary bluff, about eighty feet in height. The site of Bayou Sara is elevated, in front, above high water-mark of the river; its back part is liable to partial inundation when the river is swollen. The water then makes its way upon this portion of the town by two routes. On the west, the alluvial plain, about half a mile in width, sinks into a cypress swamp, up which the spring floods of the Mississippi creep upon the town plat. To the east, is the creek called Bayou Sara, out of which the back water of the river flows upon the same portions of the town site. Immediately above this bayou, there is a low cotton-wood bottom, which is annually overflowed to the depth of several feet. Bayou Sara is a landing place of considerable business; being the terminus of a railroad to Woodville, in the state of Mississippi.

St. FRANCISVILLE lies to the north north-east of Bayou Sara. The dry, loamy terrace on which it stands, abounds in grey sand; in which, to the east and west of the town, are deep ravines. The wet bottom or swamp below Bayou Sara, lies to the south-east of St. Francisville; and the inundated cotton-wood bottom already mentioned, to its north-west. Thus its south-east and south-west winds pass over swamps. In its rear, there are branches of the Bayou Sara, and another stream called Anderson's Creek, flowing in ravines; beyond which, the country attains a higher elevation, and is somewhat broken.

Both these towns are liable to autumnal fever, from which the upper seems to have suffered more than the lower; and both have experienced epidemic invasions of yellow fever.

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## SECTION VI.

### AN EARLY VOYAGE UP THE MISSISSIPPI.

With the preceding Section, our survey of the Delta of the Mississippi and its banks was finished. From the Balize to the mouth of Red River, we found ourselves in the midst of a highly cultivated region, and a numerous population; we saw the river and its great bayous restrained by artificial embankments; the cypress with its long moss superseded by the orange, fig, and various flowering shrubs; the natural cane-brakes replaced by fields of sugar-cane; swamps and marshes drained by the labors of art; and the very drift-wood arrested in its descent to the Gulf, and converted into fuel for the propulsion of steamboats, almost as numerous as the floating trees. We are now about to ascend the river, and observe the hygienic condition of its bluffs and bottoms, above the Delta; but before departing, I propose to offer, as an interlude, some extracts from the narrative of an early voyage, from New Orleans to the Arkansas river. It was performed by the Jesuit Father Du Poisson, one hundred and twenty years ago, and consequently but nine years

after the first settlement of the city. The reading of it will not only relieve the tedium of topographical description; but, by showing the condition of the river and its banks, while in a state of nature, will enable us to estimate more fully the transformations which civilization has effected.

#### VOYAGE OF DU POISSON.\*

"We embarked on the 25th of May, 1727, the Fathers Souel and Dumas with myself, under the direction of the good man Simon. The Fathers de Guienne and le Petit, being obliged in a few days to take a different route; the former, as you know, to the *Alibamons*, and the latter to the *Chusacs*. Our baggage and that of our boatmen occupied a space, which filled up our two boats to more than a foot above the sides. We were perched up on a heap of chests and packages, without being able even to change our position, and it had already been prophesied to us that we could not go far with this equipage. In ascending the Mississippi we coasted along by the shore in consequence of the force of the current. We had scarcely lost sight of New Orleans, when a projecting branch which had not been noticed by our holmsman, caught in a chest, overturned it, caused it to make a somersot upon a young man who was near, and rudely struck Father Souel. Fortunately it broke in this first effort, or both the chest and the young man would have been in the river. This accident decided us, when we arrived at Ohapitou-las, about three leagues distance from New Orleans, to dispatch some one to Father de Beaubois, to ask him for a much larger boat.

"During all this time we were among old acquaintances. The barbarous name which the country bears, shows that it has been in other times inhabited by savages, and at present they apply this title to five grants which are along the Mississippi. M. Dubreuil, a Parisian, received us into his. The next three belong to three Canadian brothers, who came into the country to settle, with nothing but the clothes on their back and the stick in their hand, but who have more advanced their fortunes than the grantees in France, who have sent out millions to establish their grants, which at the present time are for the most part ruined. The fifth belongs to M. de Koll, a Swiss by birth, Seigneur of the Manor of Livry, near Paris, one of the most honorable men that can be found. He had come over in the same ship with us, to see for himself the condition of his grant, for which he had fitted out ships, and subjected himself to endless expenses. There are in each of these grants at least sixty negroes, who cultivate Indian corn, rice, indigo, and tobacco. These are the parts of the colony which are most flourishing. I now am speaking to you of a grant; I shall also have occasion presently to speak of a plantation and a settlement. You perhaps do not know what all these are; have patience then to read the explanation.

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\* Early Jesuit Missions in North America: Trans. by the Rev. W. J. Kip; Part II, p. 232—252.

"They call a *Grant* a certain extent of territory *granted* by the India Company to one person alone, or to many who have formed together a partnership to clear the lands and make them valuable. These were the persons, who in the days of the great Mississippi bubble\* were called the Counts and the Marquises of Mississippi. Thus the grantees are the aristocracy of this country. The greater part have never left France, but have equipped ships filled with directors, stewards, storekeepers, clerks, workmen of different trades, provisions and goods of all kinds. Their business was, to penetrate into the woods, to build their cabins there, to make choice of lands, and to burn the canes and trees. These beginnings seemed too hard to people not accustomed to such kind of labor; the directors and their subalterns for the most part amused themselves in places where there were some French already settled; there they consumed their provisions, and the work was scarcely commenced before the grant was entirely ruined. The workman badly paid, or badly fed, refused to labor, or else seized on his own pay, and the stores were plundered. Was not all this perfectly French? But this was in part the obstacle which has prevented the country from being settled, as it should have been, after the prodigious expence which has been lavished upon it.

"They call a *Plantation* a smaller portion of land granted by the company. A man with his wife, or his associate, clears a small section, builds him a house with four forked sticks, which he covers with bark, plants some corn and rice for his food; another year he raises more provisions, and begins a plantation of tobacco, and if finally he attains to the possession of three or four negroes, behold the extent to which he can reach. This is what they call a *plantation* and a *planter*. But how many are as wretched as when they commenced?

"They call a *Settlement*, a section in which there are many plantations not far distant from each other, forming a kind of village.

"Besides these grantees and planters, there are also in this country, people who have no other business than that of vagabondizing. *First*, Women and girls taken from the hospitals of Paris, from Salpêtrière, or from other places of equally good reputation, who find the laws of marriage too strict, and the care of a single household too troublesome. Voyages of four hundred leagues present nothing to terrify these heroines; I have met with two of them, whose adventures would furnish materials for a romance. *Second*, The voyagers; these are for the most part young people sent for some reason to the Mississippi by their parents or by justice, and who, finding it too low to dig the earth, prefer engaging themselves as rovers, and wandering about from one shore to the other. *Third*, The hunters; these at the end of the summer ascend the Mississippi to the distance of two or three hundred leagues to the buffalo country; they dry in the sun the flesh on the ribs of the buffaloes,

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\* Of Law, the Scotch financier in Paris.



salt the rest, and also make bear's oil. Towards spring they descend, and thus furnish provisions to the Colony. The country which extends from New Orleans even to this place, renders this business necessary, because it is not sufficiently inhabited, or enough cleared to raise cattle there. At the distance of only thirty leagues from here they begin to find the buffaloes, and they are in herds on the prairies or by the rivers. During the past year a Canadian came down to New Orleans with four hundred and eighty tongues of buffaloes he had killed during his winter campaign with the aid of only one associate.

"We left the *Chapitoulas* on the 20th. Although we had sent for a much larger boat, and in spite of the now stowing which our people made, we were almost as much crowded as before. We had but two leagues to make that day, to reach *Burnt Canes*, the residence of M. de Bonac, director of the grant of M. d'Artagnan, where we were to sleep. He received us in a very friendly manner, and regaled us with a carp from the waters of the Mississippi, which weighed thirty-five pounds. The *Burnt Canes* is the name given to two or three grants along the Mississippi; the place is very much like the *Chapitoulas*, while the situation appears to me to be more beautiful.

"The next day we advanced six leagues, which is about as much as they can ever accomplish in ascending the river, and we slept, or rather encamped, at the *Germans*.\* These are the quarters assigned to the lingering remnant of that company of Germans who had died of misery, some at the East, and some on arriving in Louisiana. Great poverty is visible in their dwellings. It is here properly that we begin to learn what it is to voyage on the Mississippi; and I am going to give you a little idea of it, so that I shall not be obliged to repent the same thing every day.

"We had set out at the season of the heavy floods, when the river had risen more than forty feet above its ordinary level, and as almost all the country is composed of low lands, it was of course inundated. Thus we were exposed to the difficulty of not finding *cabanage*, that is to say, ground on which to do our cooking and to sleep. When we could find it we slept in this way. If the ground was still muddy, as was the case when the water began to subside, they commenced by making a couch of branches, that the mattress might not rest on the mud. Then they spread upon the earth a skin, or a mattress, and clothes, if they had them. They bent three or four canes into a semicircle, both ends of which they fixed in the earth, and placed them at proper distances from each other, according to the length of the mattress; on these they fasten three others crosswise, and then spread over this slight framework the *baire*, that is, a large cloth, the ends of which they fold under the mattress with great care. It is under these tombs, where we are stifled with heat, that we are obliged to sleep. The first thing we do on

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\* German Coast.

reaching land, is to arrange our *baire* with all diligence, for otherwise the muskotoes do not permit us to use it. If one could sleep in the open air, he could enjoy the coolness of the night, and would be too happy.

"There is much more cause of complaint when no *cabanage* can be found. Then they tie the boat to a tree. If they can find a raft of trees, they do their cooking on top of it, but if not, we go to sleep without supper, or rather we neither sup at all nor sleep at all, since we are resting in the same situation in which we were during the day, with the addition of being exposed through the whole night to the fury of the muskotoes. By the way, what is here called a raft is a collection of floating trees which the flood has uprooted: the current continually sweeping them down, they are finally arrested by some tree whose root is in the ground, or by a neck of land, and there accumulate one upon the other, and form enormous piles. We have found some which would furnish the whole of your good city of Tours with wood for three winters. These places are difficult and dangerous to pass. It is necessary to sail close to these rafts; the current there is rapid, and if it dashes the boat against the floating trees, it disappears at once, and is swallowed up in the waters under the raft.

"It was also the season of the most excessive heats, which increased each day. During the whole voyage we had but a single entire day of cloudy weather, always the burning sun upon our heads, without being able even to use over our boats a small awning which might afford us a little shade. Besides, the height of the trees and the denseness of the woods, which through all the route, are on both banks of the river, did not permit us to feel the least breath of wind. Although the river is a half league in breadth, the breeze does not make itself felt except in the middle of the stream; and it is necessary to cross it, to catch the slightest breath of air. We drew up, without cessation, the water of the Mississippi through reeds, to quench our thirst, and although it is very turbid, we experienced no ill effect. Another refreshment we had, was from the grapes hanging almost everywhere from the trees; and we snatched them in passing, or gathered them when we landed. There are in this country, at least among the Akonsas, two kinds of grapes, of which the one ripens in summer, and the other in autumn. They are of the same species; the grapes themselves are very small, and they afford a juice which is very thick. There is also another kind, the cluster of which has but three grapes, which are as large as the damask plum. Our Indians call them *asi*, *contai*: raisin, prune.

"Our stock of provisions consisted of biscuit, butter which was salt and very rancid, rice, corn, and peas. The biscuit gave out when we were a little above Natchez. Our butter was gone when we were only ten or twelve leagues distant from New Orleans; we therefore fed on the peas, and afterwards on the rice, which did not fail until our arrival at this place. The seasoning consisted of salt, bear's oil, and a particularly good appetite. The most ordinary food of this country, almost the only food of many persons,

and above all of the voyagers, is the *gru*. They bruise the corn to remove the outer skin, boil it for a long time in water, the French sometimes seasoning it with oil, and this constitutes the *gru*. The Indians pound the corn very fine, cook it sometimes with fat, but oftener with water only, and this is the *sagamite*. The *gru*, indeed, is used instead of bread; a spoonful of *gru* and a small piece of meat are taken together.

"But the greatest torment, in comparison with which all the rest would be but sport, which passes all belief, and has never been imagined in France, still less actually experienced, is that of the musketoos — the cruel persecution of the musketoos. The plague of Egypt, I think, was not more cruel — "I will send swarms of flies upon thee, and upon thy servants, and upon thy people, and into thy houses; and the houses of the Egyptians shall be full of swarms of flies, and also the ground whereon they are." They have here the *frappe d'abord*, and also the *brulots*. The latter is a species of very small gnat, whose sting is so sharp, or rather so burning, that it seems as if a spark of fire had fallen on the spot. There are also the *moustiques*, which are like the *brulots*, with the exception that they are much smaller, so that one can with difficulty see them; their attacks are particularly directed against the eyes. There are also the *guepes*, and the *thon*; in one word, there are *omne genus muscarum*.

"But none of these others are worthy to be mentioned with the musketoos. This little insect has caused more swearing since the French have been in Mississippi, than had previously taken place in all the rest of the world. Whatever else may happen, a swarm of these musketoos embark in the morning with the voyager. When they pass among the willows or near the canes, as very often takes place, a new swarm fastens with fury on the boat, and never quits it. It is necessary to keep the handkerchief in continual exercise, and this scarcely frightens them. They make a short circuit, and return immediately to the attack. The arms become weary much sooner than they do. When we land to take dinner, which is between ten o'clock and two or three, there is an entire army to be combatted. We make a *boucane*, that is, a great fire, which we stifle afterwards with green branches. But it is necessary for us to place ourselves in the very thickest of the smoke, if we wish to escape the persecution, and I do not know which is worse, the remedy or the evil. After dinner we wish to take a short nap at the foot of a tree, but that is absolutely impossible; the time allotted to repose is passed in contending with the musketoos. We embark again in their company, and at sunset, on landing, it is necessary immediately to run to cut canes, wood, and green branches, to make the *baire*, the fire for cooking, and the *boucane*. There, it is each one for himself; but it is not one army, but many armies which we have to combat, for that time of day belongs to the musketoos. One is perfectly eaten and devoured. They get into the mouth, the nostrils, and the ears; the face, the hands, the body are all covered; their sting penetrates the dress, and leaves a red mark on the



flesh, which swells on those who are not as yet inured to their bite. Chicago, to enable some of his nation to comprehend what a multitude of French he had seen, told them, that he had beheld "as many in the great village" (at Paris) "as there were boughs on the trees, and muskatoes in the woods." After having supped in haste, we are impatient to bury ourselves under the *baire*, although we know that we go there to be stifled with the heat. With what address, with what skill does each one glide under his *baire*! But they always find that some have entered with them, and one or two are sufficient to insure a miserable night.

"Such are the inconveniences of a voyage on the Mississippi. And yet how many voyagers endure them all for the prospect of a gain even the most moderate! There was in a boat which ascended at the same time with our own, one of those heroines of whom I have already spoken, who was going to rejoin her hero. She did nothing but chatter, laugh, and sing. And if for a little temporal benefit, if even for crime itself, one can endure a voyage like this, should men fear it who are appointed to labor for the salvation of souls!

"I return to my journal. On the 31st, we made seven leagues. In the evening, no *cabanago*. Water and biscuit for supper—slept in the boat—devoured by the muskatoes through the night. *Note*.—This was the Vigil of Whitsunday, a fast-day.

"The 1st of June we arrived at Ouman, a French plantation, where we found enough ground not overflowed to erect our cabins. We remained there during the next day to give rest to our crew. In the evening, Father Dumas and I embarked in a boat which during the night was to go the same distance we should otherwise have to accomplish on the next day. By this means we avoided the intense heat.

"On the 3d, we arrived, early in the morning indeed, at *Bayagoulas* (the destroyed nation), at the house of M. du Buisson, director of the grant of Messieurs Paris. Here we found some beds, which we had almost forgotten how to use, and during the morning took that repose which the muskatoes had not permitted us to gain during the night. M. du Buisson omitted nothing which could add to our comfort, and regaled us with a wild turkey. (This is in every respect like the domestic turkey, except that the taste is finer.) The grant appeared to us well arranged and in a good condition. It would have been worth still more if it had always had as good a director. Our people arrived in the evening, and the next day we left the *Bayagoulas*, charmed with the pleasant manners and civilities of M. du Buisson.

"In the evening we arrived at a spot above the *Manchat*,\* a branch of the Mississippi which empties into the Lake *Maurepas*; no ground for cooking,—no *cabanago*—millions of muskatoes during the night. *Second Note*. This was a fast-day; the waters began to fall, which gave us reason to hope that we should not be obliged to sleep much more in the boat.

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\* Bayou Iberville.

"On the 4th we slept at *Baton Rouge*. This place receives its name from a tree painted red by the Indians, and which serves as a boundary for the hunting grounds of the nations who are above and below. We saw there the remains of a French plantation, abandoned on account of the deer, the rabbits, the wild-cats, and the bears, which ravaged everything. Four of our people went on a hunting expedition, and returned next day without any other game than an owl.

"On the 7th we dined at the grant of M. Meziera: it has the air of a plantation which is just commencing. We saw there one hovel, some negroes, and a single laborer, who did us neither good nor ill. We cabined for the night at *Point Coupe*, before the house of a planter, who received us with great attention. The rain detained us there next morning, and permitted us during the whole day to make but a single league, as far as the residence of another planter. His house, which was constructed from four forked sticks, gave us, for better and for worse, a shelter from a frightful storm. How much need have these poor people of consolation, both spiritual and temporal!

"On the 9th we had scarcely embarked when there came from the woods a most execrable odor. They told us that it proceeded from an animal close on shore, which they called *bête puante* and which spreads this disagreeable smell everywhere about it. We cabined for the night at the *Little Tonicas*, in the canes; during the winter they set them on fire, but during the summer it is necessary to cut them to be able to cabin there. The Indian village is up the country; from thence to the *Great Tonicas* it is ten or twelve leagues by the Mississippi; but by land there is nothing but a mere neck which separates the two villages. Formerly they made a portage, crossing the land. They still call this passage *the portage of the Cross*. The river had penetrated this point, and inundated it entirely during these great floods, and it was this place that we had to cross the next day, that is to say, a distance of two leagues, to avoid the ten leagues which it would be necessary to go if we continued our route by the Mississippi. We accordingly took an Indian at the *Little Tonicas* to act as our guide.

"On the 10th we entered these woods, this sea, this torrent, for it is all these at once. Our guide, whose language none of us understood, addressed us by signs; one interpreted these in one way, and another in a different way, so that we did everything at hazard. However, when a person has entered these woods, it is necessary to go on or perish; for if he allows himself to get into the current for the purpose of returning, the rapid stream will certainly dash the boat against a tree, which will break it into a thousand pieces. If it had not been for that, we should have retired from such an evil undertaking immediately, as soon as we saw ourselves embarked in it. It was necessary unceasingly to turn about the boat in a zigzag course to prevent the bows from striking against the trees; and we often found it wedged between two trees which did not give it sufficient space to pass, con-

trary to the expectation of those who steered it. Now there was a torrent of which the entrance was almost closed by a raft, or perhaps by two trees of great length and enormous thickness, prostrated across the two banks of the current, and which rendered it more impetuous; now, the entrance would be entirely barred by a single tree, and it was necessary to change our direction at the risk of finding the same obstacle a moment afterward or of not finding sufficient water, but instead of it, mud and brambles. Then, it became necessary to push on the boat by main strength. Often one of our people was obliged to spring into the water even to his neck, to go and make fast the boat to a tree which extended out, so that if the strength of the current should exceed that of the oars, and cause the boat to recede, it might not dash itself against a tree. Our own boat ran the greatest risk; it began to fill in a current which had forced it back, and we saw in a moment that it was going to sink. The strength of the oars saved us, and by good fortune there happened not to be at that place either raft or uprooted trees. After having passed another, which only left a space the size of the boat, it remained for a moment immovable between the strength of the current and that of the oars; we did not know whether it was going to advance or be driven back, that is to say, for a moment we were vibrating between life and death; for if the oars had yielded to the strength of the current, we should have gone back to be dashed against a large tree which almost entirely barred the current. Our people in the other boat, who had passed before us, waited in a sad and mournful silence, and uttered a loud cry of joy when they saw us out of danger. I should never end if I were to recount to you all the toils of this day. The passage is well named *the passage of the Cross*, and a voyager who knows what it is, and does not decline attempting it, even if he should escape its dangers, merits a place in a madhouse. And by this side cut they abridge the voyage but a very short day's sail. The Lord saved our lives, and we at last reached the end and succeeded in accomplishing these two fatal leagues.

"We arrived then at four or five in the evening at the *Great Tonicas*. The chief of this nation came to the bank of the river to receive us, grasped our hands, embraced us, spread out a mat and some skins before the cabin, and invited us to sleep there. Then he presented us with a large plate of blackberries, and a *manne* (that is, a basket) of green beans. It was truly a feast for us; for the *passage of the Cross* had not permitted us to stop for dinner.

"On the 11th we passed the night for the last time in the boat. On the 12th we embarked at *Neors Blancs*, and on the 13th at *Natchez*. We immediately made our visit to the Reverend Father Phillibert, a Capuchin, who is the Curé. He is a man of good sense, who was not frightened at seeing us, as his brethren had been at New Orleans; in other respects, he is a man of worth and very zealous. We afterward descended to the bank of the river to make there our *bairea*.



"The French settlement at Natchez has become very important. They raise there a great deal of tobacco, which is esteemed the best in the country.

"We left Natchez on the 17th, and embarked, the Father Dumas and myself, in a boat which went out on a hunting expedition. Our people had not yet prepared their provisions, that is to say, they had not purchased and pounded their corn.

"As the flats now began to be seen, we found there the eggs of the turtle, which were a new feast for us. These eggs are a little larger than pigeon's eggs, and are found in the sand of the flats, where the sun hatches them. The tracks which the turtles leave, enable us to discover the places where they have concealed their eggs. They are found in great quantities, and are made into omelettes, which are much relished by people who are accustomed to eat nothing but *gru*.

"They reckon the distance from New Orleans to Natchez at nearly a hundred leagues, and from Natchez to *Yatous*,\* at forty. We made this second passage without any other adventure, except that during one night we were overtaken by a violent storm, accompanied with thunder and lightning. You may judge whether a person is well protected from the rain under the covering of a single cloth. The next day an Indian who was ascending the river with us went on shore for the purpose of hunting. We continued our route, but had scarcely gone half a league when he appeared on the bank with a deer on his shoulders. We therefore camped on the first flat we came to, for the purpose of drying our clothes and making a great feast. These repasts, which take place after a good chase, are perfectly savage in the way they are conducted, though nothing can be more pleasant. The animal is in pieces in a moment; nothing is lost; our voyagers place it on the fire or in the pot, each one according to his taste; their fingers and some little sticks supply the place of all kinds of utensils for cooking and for the table. To see them covered only with a cloth round the loins, more athletic, more browned than the Indians themselves, stretched out on the sand or squatting down like monkeys, and eating what they hold in their hands, one can scarcely know whether it is a troop of gypsies, or of people who are assisting at a witch festival.

"On the 23d we arrived at *Yatous*, a French post within two leagues of the mouth of the river of that name, which empties into the Mississippi. There is an officer with the title of Commander, together with a dozen soldiers, and three or four planters. The grant of M. le Blanc was at this place, but it has gone to ruin like the others. The ground is elevated by mounds; little of it is cleared, and the air is, they say, unwholesome. The Commander, in honor of our arrival, fired off all the artillery of the fort, which consists of two pieces of very small cannon. The fort is a barrack in

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† Yazoo River.

which the Commander lodges, surrounded by a single palisade, but well defended by the situation of the place. He received us in a very friendly way, and we cabined in his court-yard.

"On the 20th we reëmbarked, the Father Dumas and myself. From Yatonis to the Akonsas they reckon the distance at sixty leagues. We arrived there on the 7th of July, without any other adventure than having made a great feast of bear's meat, which one of our people had procured in the chase.

"After having walked about the eighth of a league, we arrived at the French dwellings. I was lodged in the house of the Company of the Indies, which was that of the Commander when he is here, and found with great satisfaction that I was at the end of those two hundred leagues which I had to accomplish. I would rather twice make the voyage which we had just finished on the sea at the same season, than to recommence this one. The Father Dumas was only in the middle of his route to go to the Illinois, and embarked again on the morning after his arrival; from this place to the Illinois country he did not find a single habitation, but they scarcely ever failed to kill some buffaloes, which very well made amends to people who had nothing to live on but some *gru*.

"I have now reached the end of my long and tedious narrative."

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## CHAPTER VI.

### THE SOUTHERN BASIN, CONTINUED.

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#### MEDICAL TOPOGRAPHY OF THE BOTTOMS AND BLUFFS OF THE MISSISSIPPI RIVER, ABOVE ITS DELTA.

In continuing to ascend the Mississippi, or great synclinal axis of the Interior Valley, it will facilitate the study of its medical topography and hydrography to divide it into natural sections, the limits of which may, on the whole, be tolerably well defined. The following are the divisions which it will be convenient to make—

- The Texas, or Concordia bottom,
- The Yazoo bottom,
- The St. Francis bottom,
- The American bottom,
- The Upper Mississippi.

## SECTION I.

## THE TENSAS OR CONCORDIA BOTTOM.

This Bottom, with but little modification of character, extends from the mouth of Red River to the diluvial bluffs, in the rear of the town of Helena, about ninety miles above the mouth of Arkansas River. It lies entirely on the western side of the Mississippi, and is about five hundred miles long. Its range of latitude is from thirty-one to thirty-four and a half degrees north. In general its lower half is wider than its upper, except where the Arkansas and White Rivers traverse the latter.

Through its whole length, near the Mississippi, there are beautiful crescent-shaped lakes, the obsolete beds of large bayous or divisions of the river, if not of the whole stream. These, and many other lakes, lagoons, and extensive swamps, are, every spring and early summer, replenished with water; for although levees have been thrown up, they never wholly prevent an inundation. There are, moreover, some other sources of supply, which must not be overlooked. *First.* Water escapes from the Arkansas River into this Bottom. *Second.* It is traversed by the Washita, which descends upon it from the highlands to the west, and often overflows its banks. *Third.* When the Mississippi is swollen, its waters flow up Red River, and then ascend Black River, the Washita, and other streams which originate in the Bottom, and thus effect an overflow of its southern portion. By the same outlet, when the great river subsides, a large portion of the diffused water is drained off. Thus the river Bouff has its origin in the largest and most northern of the lakes, called Villemonts, an old river, and discharges its waters into the Washita. Further down we have the origins of the river Tensas, which, as it flows to the south, is reinforced from Lake Providence, Lake Joseph, Lake Concordia, Lake Lovelace, and many smaller lakes and streams, before it unites with the Washita. Near their junction, the outlet of Catahoola Lake, lying to the west, likewise enters the Washita, after which the common trunk, under the name of Black River, discharges its waters into Red River, thirty miles from the Mississippi. Thus, while none of the water which escapes laterally from the bed of the Mississippi, below the mouth of Red River, ever returns, but reaches the Gulf by new channels which traverse the Delta; that which leaves the Mississippi between Arkansas and Red Rivers, is restored to the parent stream through the latter; after having inundated the Concordia Bottom. The levees designed for the protection of this Bottom, can never be as effective as those within the Delta. The range between high and low-water marks is much greater; and hence, when the river is falling, the saturated banks, lashed by the waves produced by winds and steamboats, crumble in and carry with them portions of the levee. The materials of which the levee is formed are, moreover, less argillaceous and adhesive, and therefore more readily give way under the pressure of water. Thus, this long and otherwise exceed-



ingly valuable tract of alluvion, is not likely to sustain a dense population, or to be relieved from the consequences, to health, of a yearly inundation.

The eastern boundary of this Bottom is the Mississippi; its western, as Professor Forshey informed me, is a diluvial terrace, beyond which rises a higher tertiary or cretaceous plain, covered with pine woods. That gentleman has published a map of the long parish of Concordia, extending from the mouth of Red River to a point nearly opposite Vicksburg, which beautifully illustrates the hydrography of this Bottom, by displaying its labyrinth of lakes, bayous, and cypress swamps. A section of this map, opposite the city of Natchez, constitutes *Pl. VII.*

Nearly all the redeemed and habitable land of this Bottom is found along the Mississippi, the larger bayous, and the numerous crescentic lakes. The population is altogether rural, and the staple of agriculture, cotton. The few villages which are scattered here and there, are of limited population, and can scarcely be regarded as diversifying the condition or character of its inhabitants.

In ascending the Mississippi from Red River, we have, first, *Vidalia*, opposite Natchez; then *Columbia*, sixty miles below the mouth of Arkansas River; *Napoleon*, higher up; and lastly, *Helena*, at the head of the Bottom, ninety miles above Red River. Of the first, something may be said when describing Natchez. The second is the largest of the whole, but I have not the materials for a description. The last two are so inconsiderable in size as not to merit special notices, even if I could give them.

Settled long since the Delta, the inhabitants of the Concordia Bottom are chiefly Americans; and the plantations are much newer than those of the coast below. To this cause, in part, at least, it may be owing that, although further north, they are decidedly more liable to autumnal fever (including malignant cases) than the people of the Delta. The plantations which have been longest cultivated are the healthiest. The most salubrious are those on the margin of the Mississippi, and its obsolete beds, the crescentic lakes. Yellow fever, I believe, has never invaded these plantations.

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## SECTION II.

### THE TENNESSEE BOTTOM CONTINUED—LOCALITIES ON ITS BLUFFS.

Of the bluffs on the western side of the Tennessee Bottom, I know too little to venture on a description; which, however, is not particularly required, as their population is sparse; but those on the eastern side, support several flourishing towns, which are of decided interest to the topographical etnologist. These bluffs, as we ascend the Mississippi from Bayou Sara, described on page 111, increase in height until we reach Vicksburg, and are everywhere composed of loose tertiary deposits, which the river undermines and washes away. From their summits the Concordia Bottom presents a vast grove of

oypress, liquidambar, and other forest trees, with a range of cotton fields on the right bank of the river. In describing their localities, I shall begin with that which lies furthest down the river.

I. FORT ADAMS.—This village, as its name imports, was formerly a military post, but is now an important steamboat landing, with a population of three hundred souls. It stands seventy miles above Bayou Sara, and twelve above the mouth of Red River. The Mississippi at this place approaches so near the bluffs, that many of the houses are built on its rugged declivity; the rest being near the water's edge. Of the liability of this place to autumnal fever I cannot speak; and have introduced this notice because it has suffered from yellow fever.

II. NATCHEZ.—No city in the Mexican or Southern Basin has had as many able medical historians as Natchez. Since Commissioner Andrew Ellicott sojourned there, through the summer of 1797, and made the first report on its diseases, \* we have had Doctor Porlee, † Doctor Tooley, ‡ Doctor Cartwright, § Doctor Merrill, ¶ and Doctor Monette, || who may be considered as having exhausted the subject. The causes of its having received so much attention are, its early settlement and former political and commercial distinction, together with its frequent and fatal invasions by yellow fever.

Natchez (Pl. VII) is situated in N. Lat.  $31^{\circ} 38' 37''$ , and W. Lon.  $91^{\circ} 28' 22''$ . The elevation of its site, according to Mr. Nicollet, is two hundred and sixty four feet above the sea, and one hundred and seventy-eight above the river at low water; which, consequently, is eighty-six feet above the Gulf of Mexico. In approaching Natchez the Mississippi flows nearly to the south, and when opposite turns to the west. The streets which rest upon the river, run to the south-east, and are intersected by others at right angles. The first of the latter class is not on the margin of the bluff, and thus there is, between that margin and the city plat, a promenade or narrow commons. The terrace on which the city is built, consists of alternate layers of tertiary sand and clay, with deposits of oceanic shells, the whole surmounted with a stratum of loamy marl, containing the *debris* of plants. Well-water cannot be obtained by digging into these strata, and hence, the water used by the inhabitants is, either, from the river, or out of cisterns filled during the rainy season.\*\* The surface originally rugged, has, however, been leveled by art; an enterprise which required a great deal of excavation and filling up.†† The country immediately around the city is high and deeply cut by ravines, which are destitute of water in dry weather, but convey tor-

\* Journal of Andrew Ellicott, late Commissioner, chapter 9, p. 4 to 288.

† Phil. Jour. Med. Phys. Sci. Vol. III, p. 1.

‡ Hist. of the Yellow Fever of Natchez in 1823.

§ Amer. Med. Rec. Vol. IX, p. 1.

¶ Phil. Jour. Vol. IX, p. 233.

|| Essay on the Ep. Yel. Fov. of Natchez.

\*\* Doctor Cartwright.

†† Doctor Merrill.



A  
Transverse Section  
of the  
TUBER OF THE MISSISSIPPI.  
400, miles from the Palace.

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## THE FALCON

Reduced from 10 shas  
 Map of Concordia  
 1/2 Fine Lizards  
 Cypress Swamp  
 Cotton Plantations  
 Corn Puddle  
 Scale - 1 mile to the inch

Scale - 1 mile to the inch

Jan 1945

$D.P.W. \text{ hatamog } j = \text{tof. T.S.A.}$





ronts of water during the rainy season. \* To the west of the city, one of these ravines, and a depression in the bluff from a slide into the bed of the river, were for many years receptacles for dead animals and offal of all sorts; and in a gully between them and the city, there was a collection of butcheries. † The water which falls on the town plat, is chiefly collected into two bayous. One originates west of the town, the other to its south-east, and converging, they meet and flow off by a common channel to St. Catharino's Creek, a larger stream, which passes, by a south-west course, within three miles of the city, to the Mississippi river below. There are no alluvions along the bayous which drain the city plat, but they are or have been the receptacles of a great deal of filth. ‡

*Natchez in the Country*, as the vicinity of the city is colloquially called, presents a highly cultivated and beautiful aspect, with here and there a small pond, sometimes the work of art, designed to supply stock water for the plantations.

*Natchez under the Hill*, the name given to the steam and flatboat landing, is a narrow and filthy slip of alluvion, which stretches for some distance along the base of the rugged bluff, in front of the city, and is liable to inundation in high floods. The population is compact but not numerous.

VIDALIA.—Opposite to Natchez, in the Tenness Bottom, is the small and pleasant village of Vidalia, the seat of justice for the parish of Concordia in Louisiana. It consists of a single street lying immediately behind the levee. Opposite the middle of the village, the street and levee are near the river; but above they recede from it, to keep on ground sufficiently high, and in front of them there is a depression of considerable extent, which is annually overflowed. Three miles in its rear, is one extremity of the beautiful crescent lake, Concordia, which, protected by levees, is no longer filled to repletion by the river floods. Its banks are in a high state of cultivation.

WASHINGTON.—This town is six miles north-east of Natchez, and does not belong to the river bluffs; but having been visited by yellow fever, may be described in connection with Natchez. Doctor Monette§ speaks of it, in 1827, as situated on an elevated undulating plain, well drained and dry, without swamps or stagnant water of any kind in its neighborhood. In 1844, I found this description correct; and I may add, that the spot on which it stands is tertiary, and identical in composition with the site of Natchez. The country around it is rolling and highly cultivated. The village, although one of the oldest in the state of Mississippi, is small and scatteringly built. Thus there are no topographical conditions in or around it, to prevent its being adequately washed by rains, and ventilated by winds.

*Diseases.*—Both Natchez and Washington have been, and still are, subject to autumnal fever, which annually assumes an epidemic character, and is

\* Doctor Cartwright.

† Doctor Tooley.

‡ Doctor Cartwright.

§ Western Med. and Phys. Journal (Cincinnati), Vol. I, p. 74.

oftener fatal than in the bottom on the opposite side of the river: it is, however, their liability to yellow fever, as already intimated, which gives to their topography its greatest interest.

*History.*—There are with Natchez and its vicinity, associations and recollections which tempt me to devote a paragraph to its annals. Here it was that the Natchez, the most civilized tribe of Indians in the Valley of the Mississippi, had their permanent residence; and on or near the place where the city is built, stood the Temple of the Sun, in which they maintained a perpetual fire—the object of their worship. On the spots where cotton is now planted, they cultivated maize, beans, pumpkins, and melons; compressed the occiputs of their children; ‘paid their physicians in advance’—their medicines being ‘small roots of different kinds, heads of owls, small parcels of the hair of fallow-deer, the teeth of animals, and pebble stones.’\* The first white man who went among them was St. Come, a French Catholic Missionary from Canada. Soon afterward, in March, 1700, they were visited by Iberville, from the French settlement on Biloxi Bay. He was kindly received by the Great Chief—who was Master of the Temple and Brother of the Sun. Iberville, delighted with the spot, projected a town, which he named Rosalie,—the first ever planned on the banks of the Mississippi. Thus Natchez was settled in the second year after the arrival of the French on the shores of Louisiana, and eighteen years before New Orleans.† On the 28th of November, 1728, the Indians massacred all the white men of the colony save two, (whom they purposely kept as prisoners), and a few others who escaped into the woods. They likewise destroyed all the children, amounting in the whole to two hundred; and distributing the women among the tribe, reduced them to servitude.‡ In the month of February, 1780, the French, assisted by the Choctaw Indians, in retaliation, either killed or dispersed the whole tribe. Those who escaped, assembled on Red River, where they were made prisoners, and shipped to Hispaniola as slaves.|| After this extirpation, the spot was re-peopled with French. In 1763, Louisiana passed from France to Spain, but the east bank of the river above the thirty-first degree of latitude, including Natchez, of course, was acknowledged by France to belong to Great Britain. In the same year, Spain ceded Florida to that power. For sixteen years after these cessions, Natchez was in possession of England, during which it received many adventurers from that country, and also from Ireland, Scotland, and the colonies, now United States. In 1769, the Spaniards took possession of it; and thus a Spanish element was added to the already heterogeneous population. In 1788, Great Britain relinquished Florida to Spain, the latter still retaining possession of

\* Father Le Petit: *Early Jesuit Missions*, part II, p. 280.

† *Histoire de la Louisiane*, Vol. I. Par C. Gayarré.

‡ Father Le Petit, in the *Early Jesuit Missions*, part II, p. 285.

|| Bancroft's *History of the Col. of the U. S.*, Vol. III, p. 363.



Natchez. In 1705, however, she agreed by treaty to yield it to the United States, though she did not surrender it until 1708, immediately after which it began rapidly to acquire an American population, while many of the Spaniards simultaneously left it.\*

Thus we see, that Natchez and its vicinity are not newly settled places, in transitu from a state of nature to one of cultivation; for large portions of their forest have been cut down, and the soil beneath broken up and tilled, for more than a century; thus affording a favorable opportunity for comparing their diseases with those of neighboring places, which have been but lately redeemed from the wilderness; and disclosing the influence of cultivation on the salubrity of soils of the same kind, in the same latitudes; while we learn that the population is a mixture of French, Spanish, English, Scotch, Irish, and Americans,—the last having come, at length, greatly to predominate over all the former.

III. RODNEY.—This village, forty miles above Natchez, on the same side of the river, in N. Lat.  $31^{\circ} 30'$ , is built on the upper and northern extremity of a narrow bottom, which widens to the south below the town, and at the same time becomes so low as to be overflowed when the river is in flood. Much of the bottom is wide enough for a single street only, with houses on each side; but at its upper end a square is formed; and the street on its southern side, starting from the river, passes up the deep bed of a rivulet. The water of this torrent, when swollen, passes through the village square, and under many of the houses; but when not thus swollen it flows round the square to its north, and reaches the river through a deep and foul ravine immediately above the village. From February to July the water of the Mississippi stands in this channel, which forms the boundary of the eastern and northern sides of the square, and prevents their being built upon to any considerable extent. The town was begun in the year 1828, and consists chiefly of wooden houses, many of which have their sills upon the ground and are destitute of cellars. The steamboat landing, situated opposite the lower part of the village, is considerably frequented, as Rodney is the port of a considerable region of country. Its population is about three hundred. It should be noted that although this place is ranked with the towns of the bluff, it stands upon a narrow bottom. Rodney suffers from autumnal fever in common with other towns along the Mississippi; and in 1848, it experienced a severe visitation of yellow fever.

Immediately above Rodney, there is a recess in the bluff, apparently from slides into the river. To the water in this recess, the early French voyagers gave the name of *Petit Gouffé*. A village was begun here about the same time with Rodney, and acquired ten families; but the malignity of its autumnal fever was so great, that it was abandoned for Rodney.†

IV. GRAND GULF.—The town of Grand Gulf stands sixteen miles above

\* Ellicott's Journal, p. 129.

† J. A. Watkins, M.D. penes me.

Rodney, and a mile below the mouth of Big Black, a navigable tributary of the Mississippi. Between this *embouchure* and the town, there is a promontory of tertiary rocks, against which the Mississippi, flowing nearly to the east, impinges, and is thrown off to the south with a very strong current. This creates an eddy or counter-current in front of the town. The space between this promontory and the mouth of Big Black river, received from the French the name of *Grand Golfe*; and hence, by a solecism, the name of the town. As the bluff stretches off to the south-east, and the river flows to the south south-west, the town is built in the angle formed by their divergence, on the head or upper end of a plain, which is above high water mark of the river, except in its greatest floods; but which, as it widens, sinks lower, so as to become inundated even within sight of the town. A cypress swamp, in fact, commences there, and continues for six or seven miles down the Mississippi, to the mouth of *Bayou Pierre*. Thus, while the immediate and ample site of the town is dry, even during great floods, and is at all times one of the most pleasant on the lower Mississippi, the bottom to its south-west is uninhabitable, by reason of the annual overflows which spread upward from the mouth of the stream just mentioned. The exhalations from this paludal tract, are wafted by the prevalent south-west winds of summer and autumn directly over the town; but within its own borders there are fewer accumulations of decomposable, organic matter, than in most the towns on the lower Mississippi. Being an importing and exporting town of for a considerable tract of country, steamboats land here almost daily. Autumnal fever is an annual epidemic at this place; but it has never suffered an invasion of yellow fever.

V. VICKSBURG—is situated on the eastern side of the Mississippi river, about fifty miles above Grand Gulf, sixty-five above Natchez, and four hundred and fifteen from New Orleans, on what were formerly called the *Walnut Hills*, in N. Lat. 32° 24'. While the Spaniards had possession of the left bank of the river, they maintained at this place a fort called *Noyales*. \* The city dates back no further than the year 1819. Its site, the most rugged on the lower Mississippi, is a group of tertiary hills rising about three hundred and fifty feet above the level of the sea. They were deeply cut into by ravines, which have been extensively filled up by the graduation of the streets—a work which was commenced in the latter part of the year 1836, and continued through 1837, and 1838; during which the leveling necessary to a railroad depot, and a track leading into the country, was executed. The stratum cut through in these excavations, in some places to the depth of fifty feet, was a yellowish, friable, tertiary loam. The quantity removed was greater, perhaps, than in any other town on the Mississippi River. Originally both the landing place and the business houses, were on the upper part of the narrow bottom; but a better landing below, has transferred the business; and in 1844, I saw

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\* Ellicott.

many deserted and decaying houses, with the high waters of the river in and around them. The river shore, also, abounded in sunken, or abandoned and moldering flatboats; the whole tract, in short, was extremely foul. Immediately above this spot, to the north, is the beginning of the overflowed bottom, through which Yazoo River makes its way into the Mississippi. On the opposite side of the latter, is the low Tensas Bottom, which has been described, and which is liable to annual submersion. The population of the city is between three and four thousand, the greater part of whom reside on the slopes or summits of the bluff. Vicksburg is liable to severe invasions of autumnal fever, and has several times been visited by yellow fever.

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## SECTION II.

### THE YAZOO BOTTOM.

I. This bottom, lying on the east side of the Mississippi, has its lower half (or two-thirds) opposite the upper half of the Tensas Bottom. In ascending the river from Vicksburg, where it may be said to commence, we sail north north-west, for nearly half its length, and then north north-east, for the remainder. The river bank, through the whole extent of this western boundary, is so low as to be overflowed wherever levees are not erected; and there is but one village upon it — namely, Princeton, situated about one hundred miles above Vicksburg. The eastern boundary is, in its curve, not unlike the western. It commences where the tertiary bluffs begin to recede from the river, just above Vicksburg, and ends when they return to it, a short distance below Memphis. These bluffs, in the southern part tertiary, in the northern cretaceous, everywhere constitute the eastern limit of the bottom. Its widest portion lies between Marion, Carroll county, Mississippi, and Columbia, Chicot county, Arkansas, or a little higher up, and consequently near the latitude of the mouth of the Arkansas River. The diameter of the ellipse at this point cannot be less than sixty miles; and when we extend the line to the west, across the Tensas Bottom to the terminal uplands of Arkansas, we have at least eighty miles as the breadth of the interval, or high water-trough of the Mississippi, in the latitude of thirty-three degrees thirty minutes. The hydrography of this bottom is more simple than that of the two over which we have traveled. Before levees were thrown up, the Mississippi, in every high flood, poured a sheet of water over its left bank upon this bottom; and even in moderate swells, sent out several streams, which replenished its crescent lakes — Washington, Swan, Bolivar, Horse-Shoe, and Horn; from which lakes bayous flow off through the interior of the bottom. It also sends off bayous, especially from its upper part, which may be regarded as the true sources of some of its rivers. Through these bayous, the surface of the bottom generally, is still liable to inundation, while the levees along



the bank of the Mississippi, and also those of the principal bayous, have redeemed many slips of land, which have been brought under cultivation. Nevertheless, the amount of population in this immense tract of interval land, is very little, compared with its area.

The great, or rather the only river of the bottom is the Yazoo, which joins the Mississippi twelve miles above Vicksburg. In the upper part of the bottom several bayous flow out of the Mississippi, the largest of which, not far below Hclonn, is called the Yazoo Pass. Its course is south-east across the bottom to the cretaceous bluffs, where it unites with the Tallahatchee, which has descended from the adjacent uplands. The common trunk now turns to the south, and flows near the bluffs almost to the Mississippi. On its way many tributaries from the hills flow into it. On the other side it is, near its mouth, augmented by the Sun Flower. The origin of this large tributary, is nearly as far north as that of the Yazoo; and, like the latter, it begins as a bayou of the Mississippi. In flowing on to the south it is reinforced by other bayous, directly from the great river, or indirectly from the crescent lakes. Its banks generally are overflowed during the freshets of the parent stream. It is the central stream of the bottom. Its junction with the Yazoo, is about sixty miles from the confluence of the latter with the Mississippi, near the village of Satartia.

In the month of July, 1844, I ascended the Yazoo to the city of Yazoo, formerly called Manchester, a distance of one hundred miles; the Mississippi being at the time near its extreme height. Soon after entering the Yazoo, we found ourselves in a crescent lake; then succeeded a vista through the trees, which was from one hundred and fifty to two hundred and fifty yards in width, and afforded almost the only indication of the bed of the river, so entirely were its banks submerged. Occasionally the bluffs were to be seen through the dense forest of cotton trees, sweet gum, pecan, black willow, sycamore, and cypress, the two latter, however, in reduced proportions. Cane-brakes now and then appeared. Climbing vines, such as the *Rhus toxicodendron*, *Bignonia radicans*, and a gigantic *Smilax*, overspread the limbs of the trees and bent them to the water, where their leaves floated like the foliage of aquatic plants. On every side the inundation was perfect, and, in fact, extended, with but little dry land, to the Mississippi, distant thirty or forty miles to the west. Such is the annual condition of this bottom in May, June, or July of every year. When the flood of the Mississippi subsides, this vast, temporary, and shallow lake is drained through the Yazoo; and before the month of September, much of the surface becomes so dry as to shrink until fissures are produced in the new deposits. The physicians of Vicksburg informed me, that those who travel or work in this bottom in autumn, are subject to very malignant attacks, which they are accustomed to call the 'Yazoo swamp fever.' But Doctor Mills, of Yazoo City, who had practiced many years at Satartia on the bluffs, informed me that he found the fevers of the uplands as violent as those in the bottom.

Of the towns situated on this long line of cretaceous bluffs, most of which are now and far up the Yazoo, I can say nothing except of the

II. CITY OF YAZOO.—Its site, in N. Lat. 32° 40' is a gentle slope, which ascends gradually from high water mark to the summit of the bluff, in an easterly direction. Immediately across the river there are drowned lands. The city plat is dry, elevated, and beautiful; but directly exposed to the western, south-western, and north-western winds, all of which traverse the bottom. The steamboat landing is much frequented, as this is the point to which the cotton of the back country is brought for exportation, and at which supplies for the same region are landed.

Autumnal fever prevails at Yazoo, but not beyond the degree of its prevalence on the uplands in the rear of the town; and although genuine and fatal cases of yellow fever have been introduced from the towns below, the disease has never spread. During the prevalence of that fever in Vicksburg, the intercourse with Yazoo has always been unrestricted, but the latter has never suffered a visitation.

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### SECTION III.

#### THE ST. FRANCIS BOTTOM.

I. The St. Francis Bottom begins at the dividing waters between the mouths of White River and the River St. Francis, at a point not far below the town of Helena, and extends up the west side of the river, through four hundred miles of river distance, and more than three degrees of latitude, to the low hills, on which has been built the new town of Commerce, thirty miles above the mouth of the Ohio River. Its principal river is the St. Francis, which, originating on the high lands of Missouri, in the rear of St. Genevieve, Cape Girardeau, and Commerce, enters the bottom near its head, and joins the Mississippi not far above the town of Helena, in the state of Arkansas. It has one large tributary, the Whitewater River, which flows for a considerable distance nearly parallel to it on its left or Mississippi side. When the Mississippi is in flood, an immense discharge of water takes place over its right bank into this bottom, to be returned by the St. Francis. Most of this bottom is a forest of cotton-wood, and other trees of the middle latitudes which delight in wet and fertile soils. It also has extensive cane-brakes. It seems almost unnecessary to say that such a bottom abounds in small lakes, lagoons, bayous, and extensive swamps, representations of which may be seen in *Pl. VIII.* The most extensive tracts of marsh are found along the middle portions of the St. Francis, on Whitewater River, and between them; in many parts of which, the depth of water is too great for the growth of trees, which are replaced by aquatic grasses, and other herbaceous plants, which flourish in such localities. To the west, the bluffs which terminate this bottom, rise with considerable rapidity into the

Ozark Mountains. These bluffs are but thinly peopled, and the general surface of the bottom has a population equally sparse. Even the right bank of the Mississippi has but scattered plantations, and few or no levees. But two villages on this bank are of sufficient importance to be mentioned.

II. IRENA, in latitude about  $34^{\circ} 20'$ , is remarkable for presenting us with the first land higher than the river bank, which, in ascending the Mississippi from the Balize, a distance of more than eight hundred miles, is seen on its western side. The site of the town itself is higher than the banks above and below it; while immediately back of it there are bluffs of considerable elevation. Whether they are the remains of an old diluvial deposit, or portions of the cretaceous formation, I am unable to state.

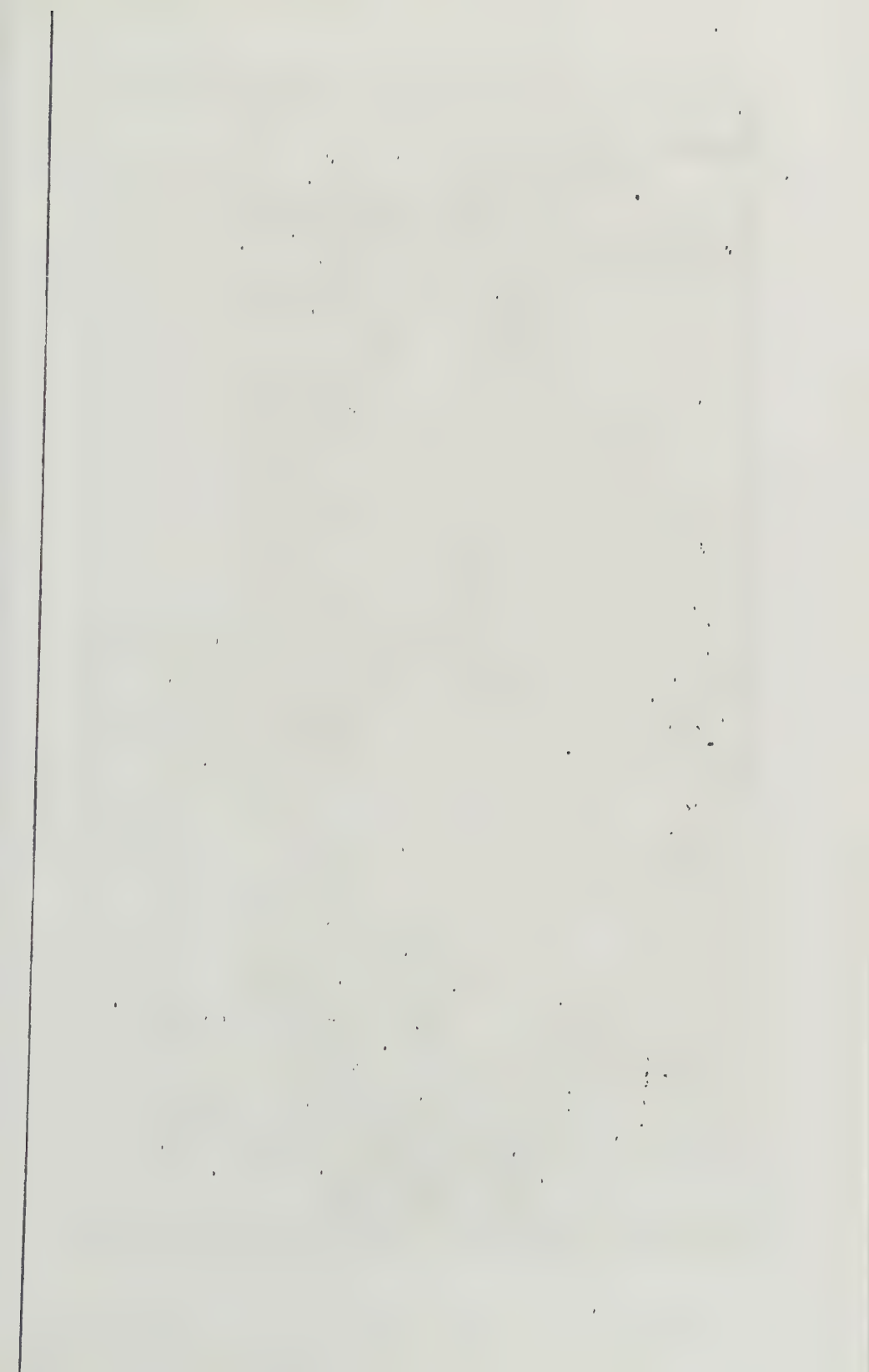
III. NEW MADRID.—This village was a military post under the Spanish régime. It is situated eleven hundred and fifteen miles from the Balize, and one hundred below the mouth of the Ohio, in Lat.  $30^{\circ} 34' 30''$  N. and Lon.  $80^{\circ} 27' 15''$  W. Its population is small; yet it has claims on the consideration of the medical otologist, as standing in the focus of the only series of earthquakes, which have agitated the Interior Valley of North America, since its discovery. Beginning on the 16th of December, 1811, they continued for the next three years, during which time but few days passed in succession, without repeated vibrations at this place and its neighborhood. Those vibrations produced in the town and the surrounding region some remarkable topographical and hydrographical changes; which, with an inquiry into the influence of the whole series of earthquakes on the health of the people, may perhaps constitute the subject of a distinct Section.

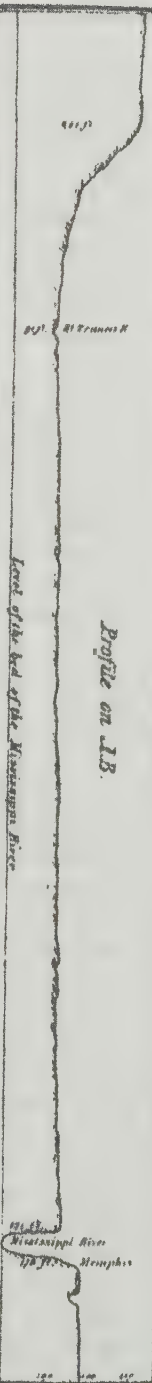
The scattered inhabitants of the St. Francis Bottom are, of course, subject to autumnal fevers, which often assume a malignant character; and returns of the intermittent form of the disease, throughout the succeeding winter and spring, are in many instances so frequent as to render emigration to some other point indispensable to recovery. As in the bottoms below, the people inhabiting the banks of the Mississippi are more healthy than those living on the streams and lakes of the interior. Yellow fever has never appeared either in Helena or New Madrid.

Let us now cross the Mississippi, and examine its eastern shores. Beginning nearly opposite the lower part of the St. Francis Bottom, and ascending to the mouth of the Ohio River, we find a series of bluffs, which alternately approach to, and recede from, the Mississippi, with intervening bottom lands at the points of recession.

The four lower of these bluffs lie in West Tennessee, and have received the name of Chickasaw, from the Indian tribe which once dwelt near or upon them. The three upper, called Mills' Point, the Chalk Banks, and the Iron Banks, are in the western part of Kentucky. They all belong to the cretaceous formation; which, in its successive outcrops from the south, of course, presents at these bluffs, which lie progressively north of each other, some







strata not soon before. 'The only important town found on these bluffs I shall now describe.

IV. MEMPHIS.—The commercial metropolis of Tennessee (*Pl. VIII\**), is built on the fourth or most southern Chickasaw bluff, at the distance of nine hundred miles from the Balize, in Lat. 35° 08' N., and Lon. 90° 06' W. Its elevation above the surface of the river at low water, is one hundred and seventy feet—over the Gulf of Mexico, four hundred. Its site is a bed of loam, belonging to the cretaceous formation. Unlike Vicksburg, Memphis occupies a gently undulating plain, on which there are some swales, but no ponds or swamps. Wells dug to the depth of from thirty to sixty feet, afford water which in most of them is very good, but in some, slightly saline and sulphurous. Immediately above the city, to the north, is the mouth of Wolf River, which has just before received the Loosahatchee, also from the north. The bottoms of this small river are wide, and subject to inundation both from its own floods and those of the Mississippi; but, except at its mouth, they are too distant from the city to exert any influence on its health. They lie, moreover, to the north-east. At, and immediately below the mouth of Wolf River, opposite the town as it was originally built, the water, at its lowest depression (which is forty-two feet from its greatest height), was formerly deep enough for steamboats to land, and portions of the bluff sometimes slid into the river; but in 1820, an eddy began to form, and deposits have been so rapidly made, that many acres are now, like the batture at New Orleans, above ordinary high water mark, and the steamboat wharf has of necessity been moved half a mile below; causing an extension, and, in some degree, a transfer of the city in that direction. West of the town, on the opposite side of the river, is the St. Francis Bottom, of which a vertical section is given in *Pl. VIII*.

Memphis deserves the attention of the medical historian on several accounts:

1. For the last few years it has increased in population with unequalled rapidity, and promises to become a large city. Its population is exceedingly mixed, and thus presents a great variety of constitutions.

2. It has been made, by the General Government, the site of a Navy Yard, which is situated at the mouth of Wolf River.

3. The cretaceous bluffs on one side of the Mississippi, and the low alluvial bottom on the other, afford to its physicians many opportunities for studying the comparative characters, prevalence, and type of autumnal fevers on the two kinds of surface.

4. Its commerce with New Orleans is great, and steamboats make the upward voyage in four days, thus subjecting it to invasions of any and every

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\* I am chiefly indebted to Doctor Shanks and Colonel Morrison of Memphis, and Doctor Borland of Arkansas, for the materials of this map, and the vertical section which it embraces.



form of disease which may prevail in that city, and can be transmitted by boats.

5. As its site is more exempt from topographical causes of fever than many other towns on the Mississippi, the question of the importation or local origin of any disease which may appear, is less complicated than elsewhere.

6. Lastly: This is the highest point up the Mississippi, and the greatest elevation above the sea, at which yellow fever has yet occurred in the Interior Valley, and it has appeared here but once; which was in the year 1828, when it prevailed as a mortal epidemic.

V. FORT PICKERING.—On the bluff, two miles below Memphis, is the site of old Fort Pickering; at which, attempts have been latterly made to build a town. Much of the tract is still covered with forest, and abounds in small shallow marshes or swales. Below it to the south there is a small stream, which enters the Mississippi on the south side of President's Island, which lies in sight of Fort Pickering. I was assured that this spot is more subject to autumnal fever than Memphis, even at the mouth of Wolf River.

VI. RANDOLPH.—This town is situated on the second Chickasaw Bluff, about seventy miles above Memphis. The bluff is higher, and more uneven on its surface, than that of Memphis. Slides are apt to occur, and its escarpment is uncommonly rugged. When visiting it, I observed the following strata, all belonging to the cretaceous formation. Beginning at the top, after a covering of soil, there is yellowish loam, becoming yellow ochre, with fragments of chert; at length growing foliaceous, and graduating into dark brown, shaly carbonaceous matter or lignite, underlaid with sand, and blue and yellow clay, mingled with shale. Slides of the bank prevented the observation from being carried lower. The surface of the bluff, although, as I have said, more uneven than that of Memphis, is less cut up by ravines than the tertiary hills of Vicksburg; and from the argillaceous character of the upper stratum, the water which falls on it is apt to be retained in small swamps, the soil of which is rich and the vegetation luxuriant. Of its autumnal fevers, I cannot speak.

Of the villages of Fulton, Mills' Point, and Columbus, on the bluffs above, I shall say nothing; but pass on to the mouth of the Ohio River. Soon after leaving Columbus, on the Iron Banks, we reach the junction of the valley of the Ohio River with that of the Mississippi. In ascending the latter to the former, for twenty miles, the bottom constantly widens, and extends with a breadth of many miles, far up the Ohio. It is heavily timbered with cotton-wood and water-maple, and is so liable to inundation as to be in a great degree uninhabitable. Geologically, it lies on the subjacent carboniferous formation, immediately north of, or beyond the cretaceous strata.

Above not less, than below the Ohio, the bottom is wide and low, subject to overflows, and abounds in ponds and swamps. This, in fact, is the general character of the promontory above the junction of the Ohio and Mississippi; and from their place of union to the rocky highlands of Illinois, the dis-

tance is ten or twelve miles. In continuing up the Mississippi, the bottom gradually narrows, at the same time becoming more elevated, and at length closes in upon the Mississippi about thirty miles above the Ohio, nearly opposite the town of Commerce, or the head of the bottom on the western side of the river. A line drawn from that point on the Mississippi to a point twenty miles up the Ohio River, would have the highlands of Illinois on its north, and the bottom which has been described, on its south. The only spot within this low, paludal, and pondy tract, that merits the attention of the medical topographer, is Cairo, immediately above the junction of the two rivers.

VII. CAIRO.—The obvious value, to the steamboat navigation, of a town at the junction of the Ohio with the Mississippi, has led to expensive attempts at building one on the low cape, or peninsula, immediately above their confluence. In its natural condition, this spot was subject, every spring, especially when the two rivers were in flood at the same time, to an inundation, from one or two, to six or eight feet, according to the inequalities of the surface, and the height of the freshets. About the year 1838, a company of capitalists undertook to throw up levees on the banks of the two rivers, and another across the peninsula, so as to inclose a sort of triangular space, sufficient for a town and its environs. This enterprise has been (imperfectly) accomplished, and there is now a small, but not very flourishing village. A part of the plan was, to throw out the water which might fall within the inclosure, or percolate its banks while the rivers were high, by means of drains to the levee, and paddle-wheels similar to those employed for that purpose in the Delta of the Mississippi. In the year 1841, when I devoted a day to the study of the medical topography of this spot, a great number of Irish and German laborers were employed on the work; and Doctor Cummings, the physician, who had spent two years among them, informed me, that they had suffered much from simple intermittent fever, into which they continued to relapse; but that malignant cases were not common. Whatever exemption from overflow the hand of labor may procure for the town plat, the drowned lands which surround it on every side, will forever subject it to autumnal fever.

The distance of Cairo from the Balize, is twelve hundred and sixteen miles; its Lat.  $37^{\circ} 0' 25''$  N., and Lon.  $80^{\circ} 2' 30''$  W. Thus it stands seven degrees immediately north of New Orleans. The surface of rivers at low water opposite the town is between two hundred and ninety, and three hundred feet above the Gulf—that of the town plat is about forty more.\*

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\* Colonel Long (*First Expedit.*) had fixed, by estimation, on three hundred feet, for the low water level of the Mississippi and Ohio at their junction; but Mr. Nicollot (*Hydr. Basin*), from barometrical observations, afterwards placed it at three hundred and twenty-four feet. Two lines of levelling from Lake Erie to the Ohio River (*Indiana Reports*) have, however, coincided in establishing three hundred and eleven feet, as its low water surface of that river opposite Evansville, two hundred miles from its mouth. Relying, as we ought, on these levellings, by which public works are constructed, both Mr. Nicollot and Colonel Long have placed the mouth of the Ohio at too great an elevation. It cannot, in fact, exceed two hundred and ninety feet.

## SECTION IV.

## GENERAL REMARKS ON THE PRECEDING BOTTOMS.

About thirty miles above Cairo, the St. Francis Bottom, as we have seen, is terminated by approximating rocky highlands. Beyond this point there is no other bottom at all comparable in width with those below. It may, in fact, be said that we have reached the vertex of the ancient estuary; whence it will be profitable to look back, for a moment, on the surface over which we have ascended. Three sections of this surface are represented in *Pls. V, VII, VIII*, and another (which illustrates the bottom above) may be found in *Pl. IX*. By comparing these diagrams, it will be perceived that the same hydrographical system prevails in all, but becomes less and less complicated as we ascend the river.

The area of this alluvial region, the most extensive in America, may be estimated, from the mouth of Red River, in latitude thirty-one degrees, to the upper extremity of the St. Francis Bottom, in latitude thirty-seven degrees and a quarter, at about twenty thousand square miles. The distance on a straight line is about four hundred miles — by the river, upward of nine hundred. In running the whole distance, the river only once (at Helena) comes in sight of bluffs on the western side, but keeps near them on the east. They consist of two series; the *first* extending from the Iron Banks below the Ohio River, to a point below Memphis — the *second*, from Vicksburg to a point below Baton Rouge. The upper are composed of cretaceous, the lower of tertiary deposits. Between these ranges of highlands, the river makes a western *detour*, and gives us the Yazoo Bottom on its eastern side. Why the stream, from the mouth of the Ohio to Baton Rouge, inclines so strongly to the eastern bluffs, cannot perhaps be told.

The redemption from a watery dominion of this great alluvial region, in which the states of Louisiana, Arkansas, Mississippi, Tennessee, Missouri, Kentucky, and Illinois participate, offers to the engineer and the physician, problems in which the public have a deep and varied interest. Without attempting their solution, I may venture the suggestion, that embankments alone will not answer, but that side channels, to relieve the main trunk, will be indispensable. The uppermost of these might be carried, from some point above the mouth of the Ohio, into Whitewater River, a branch of the St. Francis; which river, thus augmented, would return the escaped water into the main trunk opposite the upper end of the Yazoo Bottom. Through that bottom one or more sluices might be made into the Yazoo River, which joins the Mississippi above Vicksburg opposite the Tenness Bottom. To obviate the effects of this restoration, other sluices might be made below the Arkansas, into the bayous that ultimately terminate in the Washita, which empties into Red River. All the escaped water would thus, it is true, again be brought back into the main bed; but relief might be given by widening and deepening the bayous Atchafalaya, Plaquemine, Manchac, and La



Fourche, which ultimately communicate with the Gulf.\* Without thus providing lateral and parallel channels, no system of embankments along the Mississippi, could, by possibility, be made strong and high enough to protect the bottoms from inundation. Of course the banks of the auxiliary streams and sluices would require levees. In reflecting on the possibility of thus reclaiming this large tract, we must recollect that the fall from its upper extremity to the Gulf is more than three hundred feet; and, of course, if artificial channels of adequate capacity should be provided, no overflows would occur. It would aid in this work, however, in several places where the river makes *detours* and returns almost to the point of departure, to cut through the isthmus thus formed, whereby the length of the stream would be abridged, and the velocity of the current correspondingly increased.

How long a period will elapse, before the population of the Interior Valley will be dense enough, to lead to the execution of such an extended system of protection from the floods of the Mississippi, and to the complete reclamation of the bottoms, cannot be predicted; but whenever it shall be done, a signal increase of summer and autumnal salubrity must be the consequence; and no portion of the Great Valley will then present more fertile soils, and softer climates, or, taking the year throughout, more healthy residences, than the bottoms from the mouth of the Ohio to that of Red River.

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## SECTION V.

### AMERICAN BOTTOM.

I. Above the St. Francis Bottom, there are no large and continuous interval lands, until we approach the mouth of the Kaskaskia River, immediately above the village of Chester, which stands on carboniferous limestone, in the state of Illinois, about one hundred miles above Cairo. At this point we enter the American Bottom (Pl. IX). As this bottom ascends it gradually widens, until it attains, opposite St. Louis, the width of seven or eight miles. Its average width is about five miles. Its termination is at the bluffs of the town of Alton, twenty miles above St. Louis, and nearly opposite the mouth of Missouri River; making its length nearly one hundred miles. The immediate bank of the river is heavily wooded, but in the rear of this belt there is a great deal of prairie, abounding in sloughs, ponds, lakes, and bayous, which are replenished in spring, and partly dry up in summer and autumn. The inundation of this bottom is not, however, so deep and general as that of those below.

In the American Bottom there are, or were, three or four French villages: Fort Chartres, Kaskaskia, Cahokia, and Prairie du Rocher; two of which

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\* Darby's Louisiana.

are among the oldest settlements in the Valley of the Mississippi. It does not appear that their inhabitants are, or have been, much affected with autumnal fever; but many of them are rather dwarfish and shriveled.\* The Americans, who have settled in this locality, are sickly in summer and autumn. Doctor Farrer, of St. Louis, informed me, that in former years, he could distinguish, by their sallow complexion and languid aspect, the people of the American Bottom from those of the country back of the city.

On the Illinois bluffs, east of the bottom, there is no spot worthy of notice. These bluffs consist of limestone, containing beds of coal. Their elevation is from six to seven hundred feet above the sea. A considerable portion of them is appropriated to the culture of the *Ricinus communis*; and the manufacture of castor oil is prosecuted there and in St. Louis, to a greater extent than in any other part of the United States. On the Missouri side, we may pass by the old French town of Ste. Genovieve, with several newer American villages, all seated on, or at the foot of, the high bluffs of carboniferous limestone, which rise in some places like mural precipices, to the height of eight hundred feet above the sea, and stop at

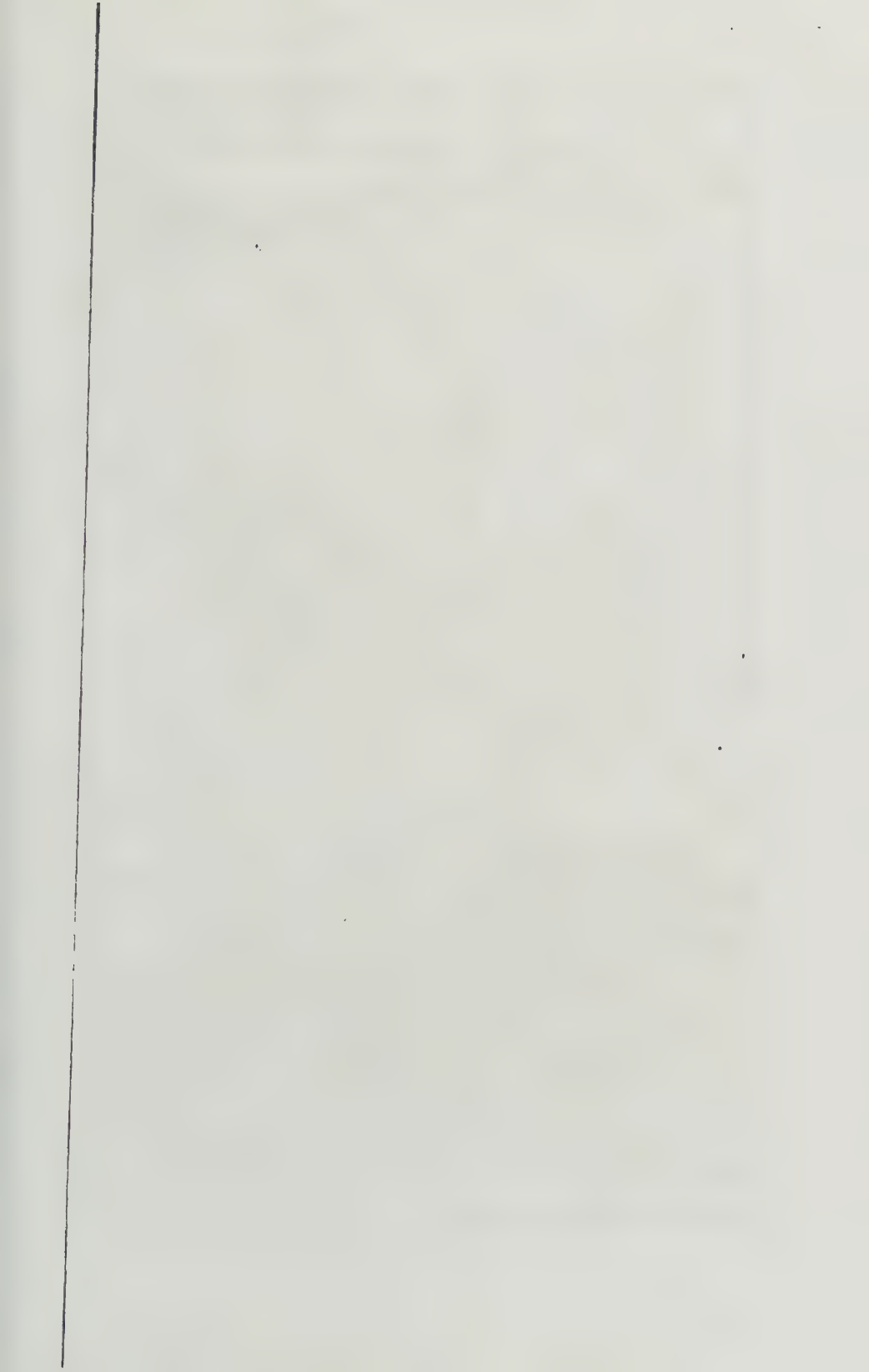
II. JEFFERSON BARRACKS.—The bluff is here more depressed and of gentler ascent from the river. This post is in Lat. 38° 28' N. and Lon. 90° 08' W. The carboniferous limestone, which abounds in coal, like the bluffs on the opposite side of the river, is considerably fractured, and portions of it are changed from their horizontal position, apparently by an upheaving force. Thus the surface is uneven, and the rents and apertures of the strata favor the drainage of the surface. A great object of the Government in establishing this post was, to have a healthy asylum for troops broken down by service in the hotter climates; to which end it would be well adapted, but for the contiguity of the American Bottom on the opposite side of the river. According to Doctor De Camp, whenever, in August or September, the wind blows over the barracks from that bottom for a few days, intermittents break out among the troops; while the people who live a mile or two from the river, in the woods, escape. The returns show a ratio of thirty-four per cent. per annum for intermittents, and of sixteen for remittents.†

From the barracks to St. Louis the distance is twelve miles. The bluffs, consisting of the same limestone, continue low, and in most places rise gently from the river. Between the two places, stands the ancient French village of Carondelet, bearing to the American Bottom a relation similar to that of Jefferson Barracks; but its native inhabitants do not seem to have suffered much from autumnal fever. Several miles higher up is the United States Arsenal, built on a gentle and rocky slope.

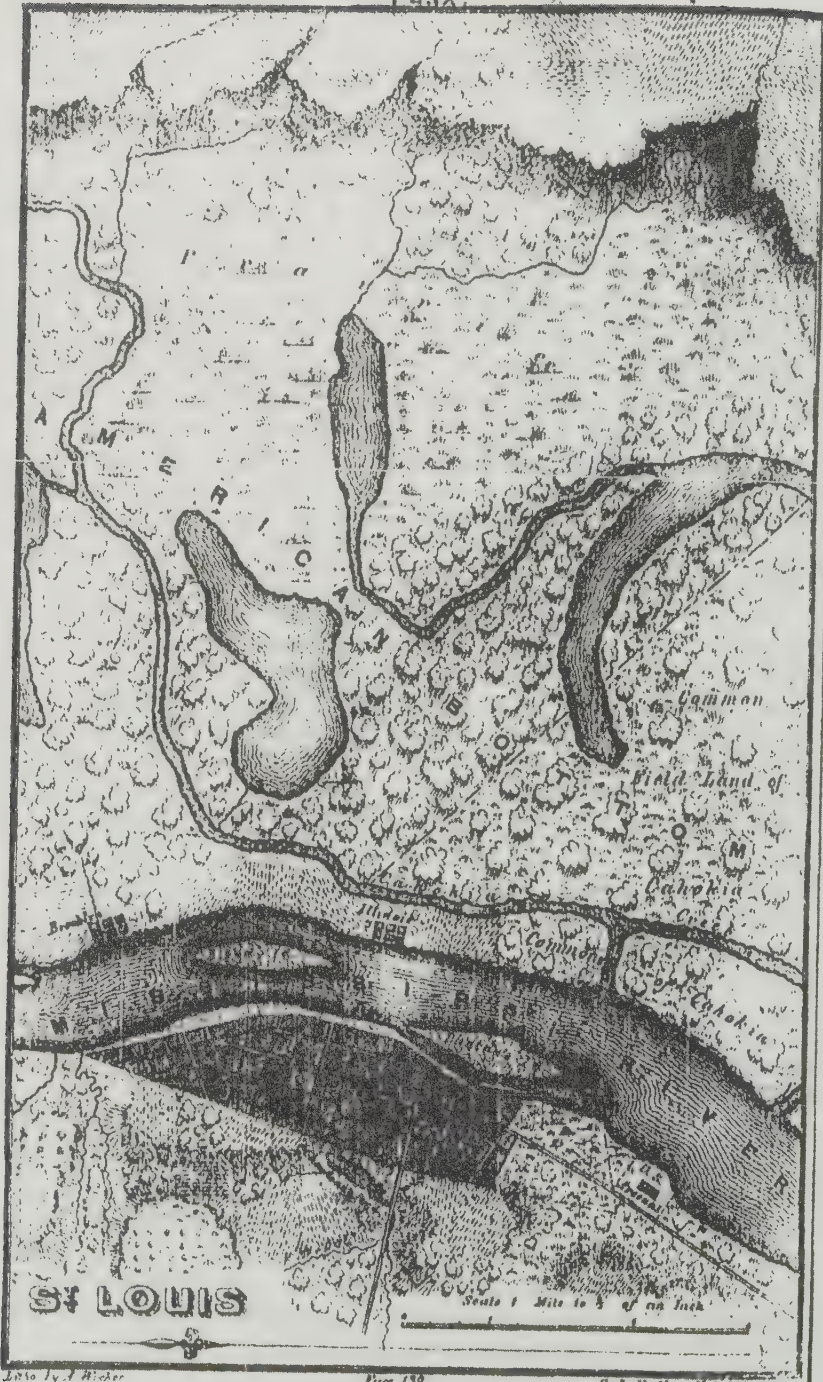
III. St. Louis.—While New Orleans is the metropolis of the whole basin of the Mississippi, St. Louis is the emporium of the northern half of that basin. Destined to be forever the most important city on the banks of the Missis-

\* Peck's Gazetteer of Illinois.

† Med. Stat. U. S. A.







issippi, above New Orleans, it may justly claim the attention of the medical etiologist.

Its distance from the Balize is thirteen hundred and ninety miles—from New Orleans twelve hundred and eighty-six. Its Lat. is  $38^{\circ} 37' 28''$  N.; its Lon.  $90^{\circ} 15' 30''$  W. Thus it stands  $8^{\circ} 40' 5''$  N. and  $16' 35''$  W. of that city. The general course of the Mississippi is well shown by these numbers. In flowing twelve hundred and eighty-six miles, and traversing nearly nine degrees of latitude, its longitudes at those cities, vary less than three quarters of a degree. According to Nicollet,\* the elevation of the river, at low water, opposite St. Louis, is three hundred and eighty-two feet above the Gulf, or three hundred and seventy-two above the surface at New Orleans. If this be correct, the fall in the Mississippi from the upper to the lower city, is three inches and forty-seven hundredths a mile; or eight inches and six tenths for each minute of latitude.

The topography of St. Louis and its environs, is so intelligibly represented in *Pl. IX.*, that a protracted description is not necessary. Its contiguity to the American Bottom, shows that it may be injuriously affected by the exhalations of that tract, when easterly winds prevail. The immediate bank on that side—the bed of the river—Bloody Island opposite the upper part of the city—and Duncan's Island in front of the lower part, are little else than deposits of sand with embedded drift-wood. The former island lies near the middle of the river; but the latter is separated from the St. Louis shore by a narrow and shallow channel. This island, like others of the Mississippi, is extending up stream by deposits on its head, and has come to interfere with the harbor. Both islands are subject to inundation, but their limited areas and sandy surfaces, prevent the formation of ponds or marshes. The upper island is covered with young cotton-trees.

The city is built in a gentle bend of the Mississippi, which flows nearly from north to south. Its site is a bed of carboniferous limestone, covered with deposits of loam; which, though generally deep, are in many places so thin that the foundations of the houses rest on the solid rock. Above the city the rocks appear in low bluffs. Those portions of the city which lie farthest down the river are built on low ground, which in high floods are subject to inundation. A bayou from the river on the west side of Duncan's Island passes through this tract, and is skirted by narrow marshes; it is also traversed by a brook from the adjoining low bluffs. In the south-western part of the city lies Chouteau's Pond—a serpentine basin of water, supplied by a small stream, and having an outlet which passes across the southern portion of the plat, in a broad ravine, to the river on the west of Duncan's Island; thus adding to the paludal character of that part of the city. The water of the pond is deep, and its margins well defined; but with the increase of population, it is becoming a receptacle for filth.

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\* Hydrograph. Basin.

In front of the city the beach or quay is narrow and paved. In the great flood of 1844, it was deeply inundated, and the first range of houses had their lower floors covered to the depth of several feet. From these houses the bank rises in a gentle and regular manner to the elevation of eighty feet above low water-mark, making it four hundred and sixty-two feet above the level of the sea.\* In advancing into the country, in any western direction, from south round to north, we either continue on this, or gradually rise to a higher level. The rocks beneath are calcareous, with beds of coal. The general aspect of the surface is that of loveliness, and some small portions incline to be swampy; but, in general, the drainage is perfect, by means of the inequalities, the fissures, and the apertures of the subjacent rock. The soil is rich and argillaceous rather than sandy, and where not cultivated is covered with a thin growth of oak and hickory trees, with copses of hazel bushes. The rapid growth of the city has led, in latter years, to a great deal of leveling, and consequently to the exposure of much new surface to the action of the elements.

The settlement of St. Louis was begun on the 15th of February, 1704; forty-six years after that of New Orleans; and twenty-four years before that of Cincinnati. Its founder was Pierre Liguette Laeclde, assisted by two young creoles, Auguste and Pierre Chouteau, all of New Orleans. A considerable French population soon collected there, chiefly from Fort Chartres, Kaskaskia, Cahokia, Vincennes, and other French villages east of the Mississippi; a region which, in 1763, had been ceded by France to Great Britain. In 1763, the town, with Louisiana generally, passed into the hands of Spain, having been previously ceded to her by France. But the immigration of Spaniards was inconsiderable, and although the town continued under Spanish rule up to 1803, the people were chiefly French. In that year, Louisiana was restored to France, and transferred, *instantly*, to the United States; whence it began to receive a new element of population. Within the last fifteen years, this population has increased at a remarkable ratio; and for five or six years past, there has been a great influx from Germany. Thus the present population consists of three kinds, the original French, the Anglo-American, and the German.

From the earliest date of its settlement, St. Louis has been an emporium of the fur trade of the west and north; and the head quarters of the *voyageurs* or *engagées* to be hereafter described. For the last twenty years, its steamboat trade has been immense; and, of course, its port has abounded in watermen of a different class. Its manufacturing population has not yet become numerous.

The inhabitants are supplied with river-water, which is received through a hydrant system, after depositing its silt in a reservoir. Situated only eighteen miles below the junction of the Missouri with the Mississippi, and on the side through which the former enters, the water pumped up for the



supply of the town is entirely from that river, which is well known to be the most turbid in the Great Interior Valley.\* The deposit from a single gallon, which I took up when the river was above its mean height, weighed one hundred and eighty grains. The greater part of this foreign matter is, however, thrown down before it leaves the reservoir.

Compared with the American Bottom on the opposite side of the river, St. Louis is but little affected with autumnal fever; nor is it as liable as the country in its rear. The parts which suffer most are the southern suburbs, and the new extensions to the west. As in our other cities, the central portions are most exempt.

## SECTION VI.

### UPPER MISSISSIPPI.

I. GENERAL DESCRIPTION.—From St. Louis to the mouth of the Missouri and the head of the American Bottom, which is found nearly opposite, the distance is eighteen miles. Here, what may be called the Lower Mississippi terminates, and the Upper commences. At this point it may be seen that the turbid waters which continue to the Baliza, and even roll the margins of the Gulf of Mexico, flow out of the Missouri; those of the Mississippi, above the junction, being transparent, and of a delicate, brownish tint. The surface of the river at this junction, when the water is lowest, is, according to Nicollet, three hundred and eighty-eight feet above the level of the Gulf. The broad alluvial bottoms are now at an end, and the carboniferous limestone bluffs are in sight at the same time, on both sides of the river. Boiling eddies, and crumbling banks, and bars, and islands composed of sand and trunks of trees bearing young groves of cotton-wood, (destined soon to be swept away), are no longer seen; but, as we ascend, broad expansions of the river, with permanent islands, overshadowed down to the water's edge, with various trees, shrubs, and herbaceous plants, meet the eye. Many of them, however, are liable to submersion during the spring freshets. For some distance up, the bottom lands are low, and, like some of the islands, are subject to inundation. At length, bowlders of various sizes, and terraces of diluvial sand, gravel, and pebbles, begin to show themselves in the rear of the alluvial bottoms. As we advance, the distance between the opposing hills gets less, the bottoms become more elevated and habitable, and the gravel banks increase in number and height. The hills, which for some distance were comparatively low, begin now to rise into greater altitude. Part of them are wooded, and part display a surface of prairie. Where a tributary enters, the valley

\* From the mouth of the Missouri to a distance of, perhaps, three miles below St. Louis, the waters of that river do not mingle, to any noticeable extent, with those of the Mississippi; but are clearly distinguishable by their color, and are found, at all points, on the western side of the river.

is generally wider, and the bottoms above and below its mouth, are so depressed as to be overflowed. In some places there are gentle rapids for many miles, the river being expanded into shoal water, flowing over a rocky bed. Such is the Upper Mississippi, as I have seen it, to the mouth of Fever River, three hundred and eighty miles above the mouth of the Missouri, four hundred above St. Louis, and seventeen hundred from the junction of the Mississippi with the Gulf. The latitude of Fever River is about forty-two degrees thirty minutes north, or thirteen degrees thirty minutes north of the Equator. From this point to the Falls of St. Anthony, five hundred miles higher, a few villages and two military posts embrace nearly all the population; and as the medical topographer is interested in none but peopled countries, I shall not attempt a further delineation, but, returning to the *embouchure* of the Missouri, give some account of a few localities.

II. JUNCTION OF THE RIVERS.—About twenty-five miles above their junction, the Mississippi and Missouri Rivers approach within nine miles of each other; whence they continue nearly parallel, in an eastern direction, until at length the Mississippi bends to the south, and receives the Missouri as a tributary. Along the Mississippi, the peninsular capo, above the junction, is, through its whole length, so low as to be subject to inundation. On the Missouri it has the same character for about twenty miles, up to the Mammelles, which are high knobs, apparently belonging to a tertiary formation.

*The Bottom.*—Most of the peninsular bottom is prairie, on the lower portions of which the river floods leave swamps, bayous, and lagoons. There are portions, however, which consist of diluvium, and are so elevated that even the great flood of 1844 did not overflow them. Its population is sparse, and subject to intermittent and remittent fevers; which, as Doctor Twyman, and Doctor Thompson, and Doctor McCullough, of St. Charles, informed me, are sometimes of a malignant character.

III. ST. CHARLES.—Three miles above the Mammelles is the old French village of St. Charles, now (in population as well as jurisdiction) an American town. It stands on carboniferous limestone rocks, which rise gradually from the Missouri to the height of eighty or one hundred feet. The country around is dry, and of the same elevation. On the opposite or south side of the river there is a heavily timbered, rich bottom, two miles wide, which is liable to be inundated. Nearly surrounded by the localities which have been described, the people of St. Charles, although its site is of a healthy character, are by no means exempt from autumnal fevers. We must now cross the Mississippi to the

IV. TOWNS OF ALTON—LOWER AND UPPER.—Not having visited these towns, nor met with a description of their medical topography, I would not mention them, but from the fact that, situated but a few miles above the mouth of the Missouri, it is predicted that they will grow into great commercial importance. Lower Alton is built on a rocky foundation between the river and the bluffs: Upper Alton is on the bluffs, two miles from the river. The

country around is said to be free from marshes; but the lower town is exposed to the exhalations from the peninsular bottom, on the opposite or western side of the Mississippi.\* Of the degree in which they are infested with autumnal fever, compared with other towns on the Mississippi, I am not informed.

V. QUINCY.—This town stands on the left bank of the river in the state of Illinois, a little below the fortieth degree of latitude. From Doctor Daniel Stahl,† I learn that its site is a diluvial terrace, eighty or one hundred feet above the river. Its composition is such that it greedily absorbs the rains which fall upon it, and favors the production of dust much more than mud. Well-water, with its usual saline impregnations, is in general use. The surface of the ground in the vicinity of the town, is elevated, rolling, and dry. An alluvial creek enters the Mississippi twelve miles above the town, and another nine miles below; but neither approaches it so near as to exert upon its inhabitants any injurious influence. In the opposite direction the condition is less favorable. Near the town, there are low, wooded islands, which are overflowed in spring, and left with ponds to be evaporated in summer and autumn: and on the further side of the river, in the state of Missouri, there is a tract of bottom, subject to annual inundation, with its consequent ponds and marshes. The surface, generally, is prairie; but on the river bank there is a grove of forest trees. These islands and the bottom lie to the west of Quincy, and the prevalent winds of summer and autumn pass over them; but the intervening trees and river may be supposed to exert a protecting influence.

Doctor Stahl has favored me with a history of the diseases in this town for the year 1842, from which it appears that no case of autumnal fever occurred in his practice until the latter part of September, and no new case appeared after a month from that time; from which we may infer that the disease is not very formidable at this place.

Quincy is a young town which has grown rapidly to a respectable size. The population is largely from New England and New York, with a few from Kentucky and other states. The European immigrants are principally German—a large element—with a considerable number from Ireland and England. Thus, like the other towns along the Mississippi, this embraces a variety of national temperaments and habits.

VI. BURLINGTON.—Doctor John F. Henry has favored me with the principal materials of the following notice of this locality. The city of Burlington, Iowa, stands on the west bank of the Mississippi river, two hundred and fifty miles above St. Louis, and a mile below the mouth of Mint River; the latitude of which, according to Nicollot, is 40° 52' 56" N., and the elevation of the surface of the river, at low water, four hundred and eighty-six feet

\* Peck's Gazetteer of Illinois.

† MS. penes me.



above the Gulf. The mouth of Flint River and the city are separated by bluffs, which here approach to the very shores of the Mississippi. Immediately below them, a slip of bottom land, about two hundred yards in width, begins and stretches for a mile down the river; having for its back ground a range of bluffs, which rise to the estimated height of about one hundred feet. A stream originating in the rear makes its way through these bluffs, and traverses the narrow bottom, near its middle, to join the Mississippi. Its valley is about three hundred yards wide, and considerable portions are liable to inundation from its own waters. The river bottom below the mouth of this torrent is likewise subject to submersion from freshets of the Mississippi. In addition, many springs burst out near the base of the hills, and water the bottom. Such is the site of the city, which is built on the narrow belt, above and below the brook by which it is traversed, and on the hills in its rear. From the mouth of Flint River, an extensive bottom stretches, for many miles, up to the mouth of Iowa River. Its average width is four or five miles; and, like the American Bottom, opposite St. Louis, it is liable to partial inundations, which, together with the descent of streams from the bluffs, gives it a surface abounding in sloughs, ponds, and bayous. The position of this bottom is directly north of the city. To the south, or below the city, the bluffs close in upon the river, and continue near it for four or five miles, when a bottom commences. On the eastern or Illinois side of the Mississippi, opposite Burlington, there is a bottom several miles wide which extends up and down the river, and closely resembles that lying between Flint River and the Iowa. In extreme floods of the Mississippi, the whole of this Illinois bottom is submerged. On the evenings of hot days, in the latter part of summer and in early autumn, the exhalations of this bottom are often extremely offensive to the smell. Finally, in the river above the city, there is a series of low, wooded islands.

Burlington is situated near the western margin of the Illinois Coal Basin, and is abundantly supplied with spring-water, having the usual mineral impregnations. As on the sites of other young and flourishing towns, there is in Burlington a great deal of excavation and leveling of the surface, which often occasions temporary ponds or sloughs.

On the subject of autumnal fever, Doctor Henry remarks — "The bottom lands above and below the city, and also on the opposite side of the river, are the chosen seats of intermittents, by which the people every year are more or less prostrated; nor do the immigrants seem to become acclimated." Remittents also occur. It is an undecided point, whether the people of the city who live on the bottom are more subject to fever than those on the bluff. The country population in the rear of the city are not exempt from the fever, especially where there is an extensive breaking up of new lands, as the beginning of cultivation. Near the river there is woodland, but prairies soon succeed, and spread off indefinitely to the west.

This description of the Burlington locality, may serve for a large proportion of the Upper Mississippi.

VII. **ROCK ISLAND LOCALITY.**—Rock Island was formerly the site of Fort Armstrong. On the western side of the Mississippi, opposite the island, in the state of Iowa, stands the town of Davenport. On the eastern, in the state of Illinois, rather below the island, stands the town of Stephenson. Three miles below is the mouth of Rock River. The whole of these properly belong to one locality, which I can describe in the most general terms only.

The island, according to Nicollot, is seventeen hundred and twenty-two miles from the Balize, and three hundred and thirty-two above St. Louis, in N. Lat.  $41^{\circ} 31' 50''$ . The elevation of the surface of the river at low water is five hundred and twenty-eight feet above the Gulf.\* The surface of the island is about twenty feet higher. Fort Armstrong, now abandoned, stood on the southern extremity of this island. Davenport is elevated above high water-mark; but to its south, at the distance of two or three miles, there is a tract of low bottom. Stephenson is on a plain less elevated than the site of Davenport, but above ordinary high water-mark. In the direction of the mouth of Rock River, this bottom sinks so low as to be subject to inundation. Thus, to the south of both towns, as well as of the intervening island, there are tracts of insubrious surface.

Of the prevalence of autumnal fever in Davenport and Stephenson, I cannot speak. Troops were stationed at Fort Armstrong for seven years, during which the ratio of intermittents was seventeen per cent., and of remittents ten per cent.†

This locality, like St. Louis, is within the Illinois Coal Basin. It lies at the foot of the Upper Rapids, the fall on which, according to Nicollot, is twenty six feet in fifteen miles.

VIII. **GALENA.**—The latitude of this town is  $42^{\circ} 24' N.$ ,—its distance above St. Louis about four hundred miles. It stands on either side, but chiefly the north-west, of Fever River, six miles from its junction with the Mississippi, in the state of Illinois. From a point one or two miles above the town, down to its mouth, this river is a mere canal, without perceptible current, except when very high, or when the Mississippi is very low. The site of the town is a ravine or chasm, with high bluffs, composed of upper Silurian limestone. Narrow as the bottom is, a part is liable to inundation during freshets of the Mississippi; but the inhabitants, for the purpose of acquiring an ample town plat, are engaged in raising it with the *debris* of the adjoining bluffs. These bluffs afford copious permanent springs of hard water. From the town down to the Mississippi, Fever River meanders through a narrow dells; but at its mouth there is an alluvial bottom of

\* Hydrograph. Basin.

† Med. Stat., U. S. A.

limited extent, liable to inundation, and a low, long island in the Mississippi, which turns the main stream of that river to the opposite or western side. The few inhabitants who have resided at the mouth of Fever River, have been very constantly affected with fever in autumn; but those of the town above are not particularly liable; and the ominous name which the river has acquired (from a corruption of *fève*, bean), is by no means appropriate. The French were the first inhabitants of this locality. At present, its population is exceedingly mixed, and embraces not a few from England, attracted thither by the lead mines.

IX. PRAIRIE DU CHIEN — FORT CHAUFORD. — Immediately above the junction of Wisconsin River with the Mississippi, lies *Prairie du Chien*, the general level of which may be seventy feet above low water. It extends up the latter river eight or ten miles, and is about two in width; being limited by a range of hills rising more than three hundred feet above it. The western margin of this plain is liable to inundation in high floods of the Mississippi; and when they subside, there remains, in summer and autumn, a long, narrow slip of marsh, abounding in decaying organic matter. Adjacent to the mouth of the Wisconsin, this slip is much wider.\* On the opposite side of the river, the high bluffs press close upon it. The cliffs of both sides present on their summits the lower strata of the blue Silurian limestone of Cincinnati, beneath which are saccharoidal sandstone and magnesian limestone down to the water's edge.† Its distance above St. Louis is about five hundred miles; its Lat.  $43^{\circ} 8' 0''$  N., Lon.  $91^{\circ} 0' 20''$  W. The elevation of the Mississippi at low water is six hundred and forty-two feet, of the adjoining hills one thousand feet,‡ above the Gulf.

This prairie enjoys the distinction of having been trodden by civilized feet before any other portion of the banks of the Upper Mississippi; as it was here that the Jesuit Father Marquette, and M. Joliet, in descending the Wisconsin River, reached the Mississippi, on the 17th of June, 1673.¶ A French fur-trading village was in due time established here, which flourished awhile and then declined. Latterly, it has attracted the attention of immigrants into Wisconsin, and promises to become a town of considerable size.

*Fort Crawford* stands on the same plain with the village, but two miles nearer the mouth of the Wisconsin; and consequently is more exposed to insalubrious exhalations. The ratio of intermittents is twenty-eight per cent.; that of remittents, four.§

X. FORT SNELLING. — This military post (*Pl. I*), the highest up the Mississippi, stands on the point of land immediately above the junction of

\* Med. Stat., U. S. A.

† Nicolle: Hydrog. Basin.

§ Med. Stat., U. S. A.

‡ Owen: Geological Rep.

¶ Bancroft: Hist. Col. U. S., Vol. III.



the St. Peter's with that river. According to Nicollet, \* the low water-surface of the rivers at this junction, is seven hundred and forty-four feet above the Gulf; the average elevation of the plain which the fort occupies, eight hundred and fifty; and the height of a neighboring hill, called the Pilot Knob, one thousand and six. The latitude of this post is  $44^{\circ} 52' 46''$  N.—the longitude  $93^{\circ} 4' 54''$  W. Its distance from Prairie du Chien is two hundred and forty miles, from St. Louis seven hundred and forty-eight, from New Orleans two thousand and eighty-eight, and from the Balize two thousand one hundred and ninety-two.† The descent of the river, following its meanders to the Gulf, is four inches a mile: on a straight line, nine and a third inches for every minute of latitude.

The Mississippi flows past Fort Snelling with a rapid current; but the current of the St. Peter's is sluggish, and the discharge of its waters into the Mississippi is impeded by an island, with a slough on the side which the St. Peter's approaches, through a low prairie bottom a mile in width.‡

The waters of the Mississippi are transparent, but those of the St. Peter's turbid and of a whitish hue, and hence its Indian name, *Minisotah*, which expresses turbidness. || To the north of the post, on the uplands, there are small lakes. § According to the army returns for ten successive years, during which the average number of troops stationed at this post was one hundred and fifty, the ratio of intermittent fever was but a fraction over four per cent. per annum, and that of remittent, two. ¶ This is a much more limited prevalence than would result from the same topographical conditions in the south, and shows, very conclusively, the influence of climate.

Having arrived at the highest settlement on the Mississippi River, it may be instructive to recapitulate, in a tabular form, the relative prevalence of autumnal fever at the military posts which stand upon its banks.

Posts.	N. Lat.	Distance from the Balize.	Elevation above the Gulf of Mexico.	Ratio per cent. per annum of Intermittents.	Ratio per cent. per annum of Remittents.
Fort Jackson,	$29^{\circ} 29'$	30 m.	4 ft.	114	15
Baton Rouge,	$30^{\circ} 30'$	145	00	51	30
Jefferson Barracks,	$38^{\circ} 28'$	1,378	460	34	16
Fort Armstrong,	$41^{\circ} 32'$	1,722	550	17	10
Fort Crawford,	$43^{\circ} 03'$	1,933	720	28	4
Fort Snelling,	$44^{\circ} 52'$	2,192	850	4	2

It will be seen from this table, that, in advancing north through fifteen degrees of latitude, and eight hundred and fifty feet of elevation, there is, with the exception of Fort Crawford (unfavorably situated near the mouth of the Wisconsin), a regular decrease of intermittent fever, from one hundred

\* Hydrograph. Basin.

† Featherstonhaugh's Geol. Rep.

‡ Med. Stat. U. S. A.

§ Hydrograph. Basin.

|| Long's Expedition, Vol. I.

¶ Ibid.

and fourteen per cent. down to four; and from Baton Rouge, the second post, a regular decrease of remittent fever from thirty to two per cent.

**XI. FALLS OF ST. ANTHONY.**—For nearly thirty miles above Fort Snelling there is a continued chain of rapids, in the midst of which are the Falls of St. Anthony, the only cascade of the Mississippi River. Its distance from the fort is eight or nine miles.

On approaching the edge of the rock from which the water is to fall sixteen feet, the river spreads out to the breadth of more than six hundred yards; but contracts below to one-third of that width, and dashes forward over masses of rock, detached from the bluffs which form the chasm. The river cascade is thus described by Mr. Keating—

“The irregular outline of the fall, by dividing its breadth, gives it a more impressive character. An island, stretching in the river both above and below the fall, separates it into two unequal parts, the eastern being two hundred and thirty yards wide, and the western three hundred and ten. The island itself is about one hundred yards wide. From the nature of the rock, which breaks into angular and apparently rhomboidal fragments of a huge size, this fall is subdivided into small cascades, which adhere to each other, so as to form a sheet of water, unrent, but composed of an alternation of retreating and salient angles, and presenting a great variety of shapes and shades; each of these forms in itself a perfect cascade, but when taken together in one comprehensive view, they assume a beauty of which we could have scarcely deemed them susceptible. We have seen many falls, but few which present a wilder and more picturesque aspect than those of St. Anthony. The vegetation which grows around them is of a corresponding character. The thick growth upon the island imparts to it a gloomy aspect, contrasting pleasingly with the bright surface of the watery sheet which reflects the sun in many differently colored hues.”

“The country about the fort contains several other water falls, which are represented as worthy of being seen. One of them, which is but two miles and a half from the garrison, and on the road to the St. Anthony's, is very interesting. It is known by the name of Brown's Fall, and is remarkable for the soft beauties which it presents. Essentially different from the St. Anthony's, it appears as if all its native wildness had been removed by the hand of art. A small, but beautiful stream, about five yards wide, flows gently until it reaches the verge of a rock, from which it is precipitated to a depth of forty-three feet, presenting a beautiful parabolic sheet, which drops without the least deviation from the regular curve, and meets with no interruption from neighboring rocks, or other impediments, until it has reached its lower level, when it resumes its course, without any other difference than that produced by the white foam which floats upon its surface. The spray, which this cascade emits, is very considerable, and when the rays of the sun shine upon it, produces a beautiful iris; upon the surrounding vegetation the effect of this spray is distinct; it vivifies all the plants, imparts to them an intense green

color, and gives rise to a stouter growth than is observed upon the surrounding country. On the neighboring rock the effect is as characteristic, though of a destructive nature; the spray striking against the rock, which is of a loose structure, has undermined it in a curved manner, so as to produce an excavation, similar in form to a Saxon arch, between the surface of the rock and the sheet of water; under this large arch we passed with no other inconvenience than that which arose from the spray. There is nothing sublime or awfully impressive in this cascade, but it has every feature that is required to constitute beauty; it is such a fall as the hand of opulence daily attempts to produce in the midst of those gardens upon which treasures have been lavished for the purpose of imitating nature; with this difference, however, that these falls possess an easy grace, destitute of the stiffness which generally distinguishes the works of man from those of nature." \*

Mr. Nicollet, in his beautiful map of the Upper Mississippi, has indicated, under the name of Cascade Creek, the stream which Mr. Keating has here described. It originates partly in Lake Harriet, which is connected by a strait with Lake Calhoun. Adjoining the latter, is the Lake of the Isles, and several others, which discharge their superfluous waters into the river at the great falls. Thus, there is much in the scenery of this wild and distant spot to feast the eye of taste, and gratify the lover of nature. It only remains for me to add, that the rocks which are here exposed consist of the oldest Silurian or transition lime and sandstone, bordering in geological position upon the primitive formations.

XII. VOYAGES ON THE UPPER MISSISSIPPI.—I have not introduced a brief description of the Falls of St. Anthony without an object which conforms to the plan of this work. Much has been published on winter resorts for invalids of the north; but the necessity of a summer voyage or sojourn, for the drooping invalidarian of the south, has been too often overlooked. To such a one, whom the heat of summer has wilted down, or the marsh exhalations of autumn have blighted, a voyage of two thousand miles directly north, should be looked upon with hope and favor. Every breath of the steam-engine would waft him into a cooler climate,—every turn of the paddle-wheel raise him to a higher level. But to make this change a blessing, he must not lounge in the cabin of his vessel, or steep himself in the fumes of brandy and tobacco at the bar, or doze and dream away the day in his state-room. To enjoy the fruit, he must pluck it with his own hands. He must rise with the sun; and only retire from his labors of active observation, when the long and deep shadows of the Rocky Mountains have gathered over him. He should not seek to pamper his appetite; petty annoyances must not fret him; and little hardships should rather be invited than shunned; for, although inconvenient at the moment, they contribute in the end to the great object for which he travels. He ought to sojourn successively in the

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\* Long's Expedition to the Source of the St. Peters, Vol. I, p. 295—302.



various young and flourishing towns to which he will be brought, and study their character and prospects; visit the mines through which the Mississippi has cut its way; descend into their shafts, and see the ore detached from its parent rocks; sally out upon the rolling prairies with his gun, and give scope to his natural instinct for hunting; or, turning from animals to plants, fill his port-folio with wild flowers, unlike those of the savannas of the south. Lastly, he should watch the unfolding scenery, as modified by geological conditions, and contrast the low and unstable alluvial and tertiary banks of the south, with the lofty out-croppings of older and deeper rocks in the north; which, even unsmitten by the prophet's rod, pour out fountains of cold water, to fall in sparkling cascades, until they mingle with the Upper Mississippi, the most beautiful of all our rivers.

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## CHAPTER VII.

### THE SOUTHERN BASIN, CONTINUED.

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#### MEDICAL TOPOGRAPHY OF THE REGIONS WEST OF THE GULF AND OF THE MISSISSIPPI RIVER.

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WE must return to the shores of the Gulf of Mexico, and rise again to the north. Keeping on the western side of the Gulf and of the Mississippi River, the region to be described extends from the basin of the Pánuco to the uppermost tributaries of the Mississippi, in one direction; and from the shores of the Gulf and the banks of the Mississippi, to the Rocky Mountains, in the other. This vast region is traversed by a great number of rivers, of which, those south of Red River pour their waters into the Gulf,—those north, with itself, into the Mississippi. Adhering to the plan of a hydro-topographical description, we must ascend the most important of these rivers, and add to their general description some brief notices of such localities as are of public interest, or fitted, by their salubrity or sickness, to illustrate the connection between the surface of a country and its endemic diseases. At first view, this undertaking appears to be of great magnitude; and so it would be, if these immense regions were peopled like many other portions of the Interior Valley; but the larger portions of them are still a wilderness, and may be dismissed with a few general remarks. This chapter, moreover,

will be kept from any great expansion, by a different cause—the want of appropriate materials for topographical description. In proceeding to execute it, under these limitations, I shall, as already intimated, commence in the far south.

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## SECTION I.

### REGION SOUTH OF THE RIO DEL NORTE.

The close approximation of the Cordilleras to the Gulf of Mexico, from Yucatan to the Rio del Norte, may be seen by a reference to *Pl. I.* The narrow zone which stretches from the base of the former to the shores of the latter, comprises the *Tierras Calientes*, or hot countries, of the Mexicans. Within the tropics it is restricted to a breadth of thirty or forty miles; but before we reach the Del Norte, in N. Lat. 20°, it widens to a hundred. In the south it belongs to the state of Vera Cruz, in the north to Tamaulipas, formerly Santander. The maritime towns of Vera Cruz and Tampico, already described, lie within these states. The southern and hottest portion of the zone, is low and level; abounds in blown sands, lakes, and lagoons; has very little fertility, and supports but a limited population. The northern ranges of the *Tierras Calientes*, while they suffer less from tropical heats, have a richer soil and greater breadth. The rivers of this more favored portion are, the Panuco, Tamaulisco, Santander, and Fernando, which descend from the flanks of the Cordilleras, and refresh the plain on their passage to the Gulf. Thus fertilized, the population of the northern parts of the zone, is greater than of the southern; but of the degree in which they are infested with autumnal fever, or of the modifications which it presents, I am unable to speak.

In the rear of this zone, we come to the *Tierras Templadas*, or temperate countries. They comprehend the *Sierra Madre*, and other mountains which flank the Cordilleras, and at the height of from four thousand to six thousand feet, present terraces on which stand the cities of Jalapa, San Luis Potosi, and Saltillo. In vegetation and climate this zone differs essentially from that beneath, and it enjoys a remarkable exemption from the fevers which infest the *Tierras Calientes*. Behind, and at an increased elevation, are the *Tierras Frias*, or cold countries, of which the elevation is above seven thousand feet, and the productions and diseases of a kind corresponding with the temperature. Thus, in ascending from the Gulf under any parallel of latitude, a distance of two hundred miles carries us from the suffocating heats and pestiferous exhalations of the *Tierras Calientes*, to regions which, although never very cold in winter, are delightfully temperate and healthy in summer. This limited range between the maximum and minimum temperatures of the year, broadly distinguishes the effects of elevation under the same parallel, from those of higher latitude, in ascending the Interior Valley

from the Gulf of Mexico. For example, if we advance to the north so far as to find a summer equally cool with that of the *Tierras Templadas*, we have a winter too rigorous to be borne—the range between those two seasons becoming longer as we proceed from the tropical zone. Within the basin of the small Rio Fernando, or Tigre, which traverses the northern part of the *Tierras Calientes*, there are two towns, Monterey and Saltillo, which merit a more extended notice than I am able to give them. I shall say a few words of the former only.

MONTEREY—near the twenty-sixth degree of north latitude—stands at an elevation of about fifteen hundred feet above the sea. Doctor Proctor, in his account of the diseases of a portion of the army, in 1846 and 1847,\* speaks of the troops as being encamped near the city, in a low bottom, abundantly watered, and surrounded by swamps. This condition of the surface sufficiently explains the prevalence of intermittent fever, which they experienced.

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## SECTION II.

### BASIN OF THE RIO DEL NORTE.

I. The origin, course, and termination of this river, the longest, except the Mississippi, which throws its waters into the Gulf of Mexico, has been given at page 14. Its lower half constitutes the dividing line between the United States and the Republic of Mexico. According to Doctor Clogg,\* the Del Norte is a broad, shallow stream, eminently alluvial, and abounding in sand-bars and snags. Its direct descent from the Rocky Mountains gives it many rapids and ripples, so that its navigation is of little value; which, taken in connection with the sterility of much of the country through which it flows, will prevent the population of its banks and bottoms—at present sparse—from ever becoming very dense. These banks in many places are not more than ten feet above low water-mark, and yet, so great is the breadth of channel, that the water does not rise high enough to overflow them. In fact, the Del Norte has but few tributaries, and in its descent loses so much water by infiltration through the sand, that its depth rather diminishes than increases with its progress; thus reversing the law which governs the Mississippi. About the middle of its length, portions of it, in long droughts, sometimes entirely disappear by absorption.

The geographical position of the Del Norte gives it an etiological importance, which will be appreciated when its topography, climate, and diseases are better known than at present. This importance results from its valley being the natural terminus on the south-west of the vast plains which

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\* West. Jour. (Louisville), June, 1848.

† Com. of the Prairies, Vol. I, p. 138.



lie between the Mississippi and the Rocky Mountains. Even before reaching it from the north, detached ridges of that chain are encountered; while immediately beyond, the flanks of the Cordilleras of Mexico are close at hand. As many years will elapse before there will be much population near the base or on the slopes of the great mountain chain in higher latitudes, we must look to the Del Norte for those modifications which diseases undergo from change of topographical elevation.

The valley of the Del Norte, below the Presidio del Rio Grande, about the twenty-eighth degree of north latitude, has a general aspect of levelness, with tracts of swamp, and some small lakes of salt water. In general the soil is not deep, and in some parts so poor and sandy that the country is almost a desert. Prairies are common; the forests are thin, and composed of stunted trees; the prickly-pear (*Cactus*) infests the surface, and everywhere good water in the form of springs or streams is wanting.

II. MATAMORAS.—This Mexican town stands on the right bank of the Rio del Norte, fifty miles, by its meanders, from the Gulf of Mexico. The river, at the town, and below, as I am informed by Doctor Langdon, who, during the late war, was for some time stationed at Matamoras, is narrow, muddy, rapid, and eddying; on the whole, it resembles the Mississippi; even, like it, having no tidal estuary. The country on each side, from the mouth of the Del Norte to the town, and above, is level and sandy, with groves of small timber and an abundant growth of the prickly-pear. Immediately above the town, the river turns from its general south-eastern course, to the east; and after making a bend of many miles, returns below the town, on the south, so near as to be in sight. In this bend there is a small, permanent lake, or pond, which occasionally in river floods extends its area to the edge of town. To the west of the town there is a larger lake, about two miles long, which becomes dry in the month of August. To the north and south of this lake, the ground is a little more elevated than that on which the town is built, and covered with small trees. On the whole, there seems to be but little drowned or swampy land in the vicinity of Matamoras. It does not appear to be liable to yellow fever. Of the extent to which its inhabitants are subject to autumnal fever, I cannot speak. The troops had both intermittent and remittent fevers, but not to any remarkable degree; and their types were nearly the same that Doctor Langdon had been accustomed to see in the neighborhood of Cincinnati.

III. PRESIDIO DEL RIO GRANDE—SANTA ROSA—MONCLOVA.—In the absence of materials for a methodical topographical description of the region on each side of the Lower Del Norte, I may give the following extract of a letter, written from Monclova, in Mexico, by Doctor Gregg, who was attached to the army commanded by General Wool:

"I have been surprised during our march, to hear of a considerable amount of intermittent fever among the Mexicans. At *Presidio del Rio*

*Grande*\* (in N. Lat.  $28^{\circ} 20'$  and W. Lon.  $100^{\circ} 30'$ ), a town of some two thousand inhabitants, many of the natives were suffering with chills and fevers, up to the middle of October, the time of our being there. Eight or ten days afterwards, I found the same disease still more prevalent (though by no means as bad as in many parts of the Valley of the Mississippi during autumn), in Santa Rosa, a town of near three thousand inhabitants, in about N. Lat.  $27^{\circ} 54'$ , and (approximately) in W. Lon.  $101^{\circ} 40'$ . The Presidio is situated virtually in the valley of the Rio Grande (being only five miles west of it, on a small tributary); but Santa Rosa is entirely inland, being at the eastern base of a lofty and extensive ridge of mountains, which divides the waters of the Rio Grande from those of the interior of Mexico. Since leaving Santa Rosa, we have never been entirely out of sight of mountains; and at this place (Monclova) we are completely surrounded by them, though the city itself is in the border of an extensive valley, looking to the northward. But even here (N. Lat.  $26^{\circ} 54'$ , W. Lon.  $101^{\circ} 37'$ ) I find the people afflicted to some extent with the same fever. Now, Santa Rosa and Monclova, with the intervening and surrounding country, certainly do not, *naturally*, abound in the conditions to which, by observation, we are led to ascribe autumnal fever; and I am disposed to attribute the fever which now prevails to an *artificial* cause. Irrigation, you are aware, is extensively resorted to in all the agricultural operations of this people, who cultivate sugar, cotton, and Indian corn, in abundance, but are obliged to depend on irrigation. If the surplus water were returned to the streams by ditches, there would, perhaps, be but little malaria produced; but it is generally suffered to run into the lower flats, and give origin to permanent ponds and marshes. There are marshes below the Presidio, more extensive ones about Santa Rosa, and many of considerable size in the vicinity of this city; all of which appear to have been produced in the manner I have pointed out."

In ascending to what may be called the Middle Rio del Norte, the country becomes more elevated and broken.

IV. CHIHUAHUA — the capital of the state of Chihuahua — stands on the banks of the Conchas, a small, western tributary of the Rio del Norte. "Although situated about one hundred miles east of the main chain of the Mexican Cordilleras, Chihuahua is surrounded on every side by detached ridges of mountains, but none of them of great magnitude. The elevation of the city above the ocean is between four and five thousand feet; its latitude is  $29^{\circ} 36'$  N.; and its entire population numbers about ten thousand souls."† I am not informed as to the prevalence of autumnal fever in this locality.

V. FROM CHIHUAHUA TO THE EL PASO DEL NORTE.—The latter town or settlement, is found on the western side of the Rio del Norte, two hundred and thirty miles north of Chihuahua, and two hundred and twenty below

\* Rio del Norte.

† Com. of the Prairies, Vol. II, p. 114.

Santa Fé. The character of the middle portion of the basin of the Rio del Norte, may be understood from the following paragraph, by Doctor Gregg:\* "The road from El Paso south is mostly firm and beautiful, with the exception of the sand hills before spoken of; and is only rendered disagreeable, by the scarcity, and occasional ill savor of the water. The route winds over an elevated plain, among numerous detached ridges of low mountains—spurs, as it were, of the main Cordilleras, which lie at a considerable distance to the westward. Most of these extensive, intermediate plains, though in many places of fertile-looking soil, must remain wholly unavailable for agricultural purposes, on account of their natural aridity, and a total lack of water for irrigation." Doctor Gregg does not tell us whether this region is infested with autumnal fever.

VI. EL PASO DEL NORTE.—This locality is the most attractive in the valley of the Del Norte. It will have at last the densest population, and prove to be that in which the most interesting observations on the diseases of that valley will be made. According to Mr. Hughes, † "the settlement of the El Paso extends from the falls of the Rio Grande on the north, to the Presidio on the south, a distance of twenty-two miles; and is one continuous orchard and vineyard, embracing in its ample area an industrious population of at least eight thousand." It is "isolated from all other Mexican settlements by the mountains which rise on the east and west, and close in to the river on the north and south. The breadth of the valley is about ten miles." It is irrigated by water taken from the Del Norte above the scattered village of El Paso. The freshets of the river do not overflow this bottom. The surrounding highlands are generally destitute of timber. In latitude, the Paso is a little below the thirty-second degree north.‡ According to Kendall, the population of this oasis of the desert, is chiefly Spanish, unmixed with Indian.§ Of its autumnal fevers, I cannot speak, from want of information.

VII. SANTA FÉ.—We ascend to Santa Fé by passing through a country but thinly inhabited. This town, well known as the capital of New Mexico, stands in N. Lat. 35° 41', and in W. Lon. (about) 106°. Its elevation above the ocean is estimated at seven thousand feet.§ According to Doctor Gregg, ¶ "its situation is twelve or fifteen miles east of the Rio del Norte, at the western base of a snow-clad mountain, upon a beautiful stream of a small mill-power size, which ripples down in icy cascades, and joins the river some twenty miles to the south-westward. The population of the city itself but little exceeds three thousand; yet, including several surrounding villages, which are embraced in its corporate jurisdiction, it amounts to nearly six

\* Com. of the Prairies, Vol. II, p. 83.

† Doniphan's Expedition, p. 282.

‡ Com. of the Prairies, Vol. II.

§ Narrative of the Texan Expedition, Vol. II.

¶ Com. of the Prairies, Vol. I, p. 144.

¶ Ibid.



thousand souls." This is something more than the population of the entire province of New Mexico, as estimated by Doctor Gregg. The great obstacle to a dense population in this region is the want of water; and hence nearly all the agriculturalists live along the Del Norte or its few tributaries, and resort to irrigation. In such a region, ponds and marshes are, of course, nearly unknown; and the diseases to which they give origin, almost as rare, as will appear from the following statement, by Doctor Gregg: \*

"Salubrity of climate is decidedly the most interesting feature in the character of New Mexico. Nowhere—not even under the boasted Sicilian skies—can a purer or a more wholesome atmosphere be found. Bilious diseases—the great scourge of the Valley of the Mississippi—are here almost unknown. Apart from a fatal epidemic fever of a typhoid character, that ravaged the whole province from 1837 to 1839, and which, with the small-pox that followed in 1840, carried off nearly ten per cent. of the population, New Mexico has experienced very little disease of a febrile character; so that as great a degree of longevity is attained there, perhaps, as in any other portion of the habitable world. Persons, withered almost to mummies, are to be encountered occasionally, whose extraordinary age is only to be inferred from their recollection of certain notable events, which had taken place in times far remote."

Santa Fé, of which this favorable account is given, lies under the same parallel with Memphis and the southern portion of the St. Francis Bottom; which were described in the last chapter as having an elevation of three hundred feet above the sea, with an excess of moisture, and abounding in autumnal fevers of a fatal character.

VIII. VALLEY OF TAOS.—The last locality within the basin of the Rio del Norte, which I shall mention, is Taos, lying above Santa Fé, in N. Lat. 36° 20'. The stream which flows through this valley, enters the Del Norte by its left bank. The settlements in this valley are among the most northern of that river. According to Doctor Gregg,† "no part of New Mexico equals this valley in amenity of soil, richness of produce, and beauty of appearance." As this distant region (it may be hoped) will hereafter be visited by certain classes of invalids, I will transcribe from Doctor Gregg, the following notice of a natural curiosity:‡ "Opposite Taos, for an uninterrupted distance of fifteen miles, the Rio del Norte runs pent up in a deep cañon (gorgo), through which it rushes in rapid torrents. This frightful chasm is absolutely impassable; and viewed from the top, the scene is imposing in the extreme. None but the boldest hearts and firmest nerves can venture to its brink and look down its almost perpendicular precipice, over projecting crags and deep crevices, upon the foaming current of the river, which in some places appears like a small, rippling brook."

\* Com. of the Prairies, Vol. I, p. 146.

† Ibid, p. 145.

‡ Ibid, p. 138.

We must now take leave of these detached and extreme western settlements, of the Great Interior Valley, and return to regions nearer the Gulf of Mexico.

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### SECTION III.

#### SOUTHERN TEXAS.

Between the Lower Rio del Norte and the Lower Mississippi, there is a region watered by the following rivers, beginning to the south-west:—Nueces, San Antonio, Guadalupe, Colorado, Brazos, San Jacinto, Trinity, Neches, and Sabine; not to mention smaller intervening streams. The longest of these numerous rivers are limited to the north by the water-shed between them and Red River, which, behind the state of Texas, runs nearly from west to east, about the thirty-fourth degree of latitude; the shorter ones arise much nearer the Gulf; into the numerous shallow bays and sounds of which, they all discharge their waters, between the latitudes of twenty-seven and a half and thirty degrees north. It is the north-west segment of the Gulf which receives these contributions—more copious than those poured into any other equal portion of its coast, from the Delta of the Mississippi round to Yucatan; a sufficient evidence that the region from which they flow, is neither so deficient in rain, nor abundant in absorbing sands, as that of the Rio del Norte further west.

Not having visited any part of this group of river basins, nor seen their medical topography described, I cannot speak of them except in the most general terms. Mrs. Holley\* informs us that Texas, as it was then bounded, by the Nueces to the west, and Red River to the north, presents three zones or regions,—the level, the undulating, and the hilly. The level occupies the entire coast, extending from thirty to eighty miles into the interior, and corresponding, except in latitude, to the *Tierras Calientes* of the western side of the Gulf. The whole Gulf-margin of this zone, from the Nueces to the Sabine, has a belt eight or ten miles wide, consisting of prairie, except along the streams. Although low and extremely level, it is almost free from marshes. That part of the level region which extends back between the San Jacinto and Sabine Rivers, about seventy miles from the coast, is in general heavily timbered. The section of level country which lies between the San Jacinto and Guadalupe, extends back about eighty miles; is sufficiently elevated for perfect drainage after rain; and presents few swamps or ponds. The bottom lands of the Brazos, San Bernardo, and Colorado, are from three to twenty miles in width, and heavily timbered, presenting cane-brakes of

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\* Texas. By Mrs. Mary Austin Holley: Lexington, 1836. This late accomplished and gifted lady, a niece of Moses Austin, the pioneer of the American emigrants to Texas, resided for some time in the region she has described.

immense extent. That portion of the level land which lies between the Guadalupe and the Nueces, is narrower, but at the same time more elevated, than the regions just described.

We come now to the undulating zone. Between the Sabine and San Jacinto Rivers, the country is undulating to Red River, on its north, and never rises into ridges higher than those which belong to a rolling country. It is partly wood-land and partly prairie,—everywhere well watered. North of the level country from the San Jacinto to the Guadalupe, the surface is gently undulating, diversified with prairie and forest, and abundantly supplied with permanent springs. West of the Guadalupe to the Nueces, a similar surface is found. We come now to the third division.

"The mountain range of Texas may very properly be called a spur of the Sierra Madre (Mother Ridge), which it leaves near the junction of the Rio Puerco with the Del Norte, and, pursuing a north-easterly direction, enters Texas at the sources of the Nueces River. Thence, continuing in the same direction to the head waters of the San Saba, a branch of the Colorado, it inclines to the east down the San Saba; crossing the Colorado some distance below the mouth of that river, it is finally lost in the undulating lands of the Brazos. This range does not cross the Brazos. The country east of this river and upon Trinity River is gently undulating, and in some districts quite level; this description of surface extending the whole distance to Red River. Spurs of this mountain range extend southwardly, down the rivers Medina and Guadalupe, to the vicinity of Bexar. Spurs also extend down the rivers Sanos and Pedernales, and the smaller western tributaries of the Colorado. Similar spurs stretch up to the Colorado above San Saba to a considerable distance, and round the head-waters of the San Antonio and Bosque, tributaries of the Brazos.

"The mountains are of third and fourth magnitude in point of elevation. Those of the San Saba are much the highest. These are, in many places, thickly covered with forests of oak, cedar, and other trees, interspersed with a great variety of shrubbery.

"This range of high land on its north-western frontier, is of vast advantage to the state of Texas. It not only renders the atmosphere more salubrious, but, abounding in copious fountains of limpid water, it gives rise to the numerous rivulets which, having first irrigated their own fruitful valleys flow off with a rapid current, and unite to form the large rivers of the central and western parts of the state. These last-mentioned rivers are uniformly more limpid than the rivers to the east of the Brazos.

"North of this mountain range, and on the extreme head-waters of the Brazos River, the country becomes level again and presents to the view interminable prairies. These stretch to the north and north-west beyond Red and Arkansas Rivers, and are finally lost in the vast ocean of prairie that terminates at the foot of the Rocky Mountains." \*

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\* Texas, by Mrs. M. A. Holley, p. 21—23.



This outline of the physical geography of Texas, even if not too favorably drawn, lays but a foundation for its medical topography; and even on this foundation, for want of the requisite materials, I cannot build. I can, however, give an additional and corroborative notice of one portion of this extensive region, in an extract of a letter from Doctor Gregg:\* "The general character of this country, to the southward, that is, between this and the coast, is level — chiefly high and dry plains, with fertile soil, abounding in vegetable remains; in many places, alluvial; in others, more elevated, containing silicious pebbles. These plains appear to be based on what I have always called *rotten* limestone, a soft, friable, semi-decomposed carbonate of lime (tertiary or cretaceous). But to the north we have a hilly or low mountainous region, with strata of firmer limestone. At the base of these hills the San Antonio takes its rise, by numerous springs of pure water, one of which is exceedingly copious, and, during the month I have been here, has had a daily morning temperature of seventy-six degrees, and an afternoon temperature of seventy-eight degrees, Fahrenheit. This is a very healthy region of country, I am sure; yet I find some autumnal fever among the inhabitants, and still more is occurring to the troops; but they have been marching through more insalubrious regions. The town stands in Lat. 26° 25' 30" N., and Lon. 98° 50' W. Its population is about two thousand — chiefly Mexican. This place is so far west that the nights in summer and autumn are dry. I am disposed to think that it is near the western limit of the epidemic prevalence of autumnal fever."

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## SECTION IV.

### VALLEY OF RED RIVER.

1. GENERAL DESCRIPTION.—We have taken leave of the rivers which, to the west of the Gulf and the Mississippi, flow directly to the former; and reëntering the Mississippi basin, will ascend; and must now advance gradually through its western half, to the northern limits of its settlement.

Red River, a large, and the most southern, tributary of the Mississippi, mingles its reddish-colored waters with the chocolate-tinted currents of the Great River, in the N. Lat. 31° 2' 25", at the vertex of the Delta. In consequence of its low latitude, and its flowing nearly east for the first half of its length, Red River throws out its annual flood in the month of February; while the more northern tributaries of the Mississippi are still looked up. In tracing the course of the river from its mouth to its sources, we pass to the north-west, and very soon to the west, until we reach the Llano Estacado, on which it chiefly originates. Restricted to the north by the river Arkansas,

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\* Dated, San Antonio de Bexar, September 25th, 1846.

and on the opposite side by the rivers of Texas, which flow directly south to the Gulf, the basin of this river is long, narrow, and, near its middle, bent almost to a right angle. It is chiefly the portions below this bend, within the limits of the state of Louisiana, that present at this time anything of interest to the medical topographer. Throughout its upper half, its annual swell pours, through numerous outlets, and over its low banks, a deluge of water, which collects into lakes or reservoirs on both sides of the river, and thus diminishes the inundation. When the river sinks in summer and autumn, most of these safety-basins, by outlets from their lower sides, send back their waters to the river, and many of them even have their bottoms covered with grass. The distant highlands on both sides, are tertiary or cretaceous pine terraces, which extend down to, or below, the town of Alexandria, one hundred miles above the junction of the river with the Mississippi, where they trend away to the north-east from the left bank of the river, and to the north-west from its right; and thus the valleys of the two rivers are blended into one, in which the deposits of the two rivers are distinguishable—those of the Mississippi being some shade of blue, and those of the other streams, a tint of red. In all other respects, their medical topography is so much the same as to render a further description unnecessary.

The streams generally, which, from the north, fall into Red River below the great bend, are limpid; but those of the south, and many of its upper tributaries on both sides, have a reddish turbidness, and a brackish taste, from traversing rock-salt formations. The redness is from clay, colored with peroxyde of iron, the saltiness from muriate of soda—both of which impregnate its alluvial soil, and are regarded as the elements of its unrivaled fertility.\* We must now notice a few localities.

II. ALEXANDRIA.—This town occupies the right bank of the river, at the foot of its rapids, in the parish of Rapide, distant from New Orleans three hundred and thirty-six miles, and from the mouth of Red River about one hundred. The plain on which it stands rises above high water, but gradually sinks to the cypress-swamp level, and continues so for fifteen or twenty miles back from the river. Immediately above the town is the foot of the rapids, which, when the river is low, cause the navigation to terminate at Bayou Rapide. The banks of this bayou are sufficiently elevated for cultivation. Alexandria suffers equally with the towns of the upper part of the Delta from autumnal fever, and has once been visited by yellow fever.

*Pine Lands.*—Opposite Alexandria the pine lands approach to the very shore of Red River. This plateau is handsomely undulated with hill and dale, and in the valleys there burst out innumerable springs. The streams have transparent water, flowing generally over white sand. The soil is comparatively poor, except the narrow intervals of the streams, which abound in magnolias, flowering shrubs, and climbing vines, with the speckled trout in

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\* Darby and Filat.

the shaded waters beneath. Finally, the air has a balmy and terobinthine odor.\* These pine woods, like those nearer the Gulf, already described, are proverbial for their freedom from autumnal fever.

III. NATCHITOCHES.—This old, originally Spanish, town is situated on the right bank of the river, eighty miles above Alexandria, in N. Lat.  $31^{\circ} 40'$ ; and, in consequence of the rapids which have been mentioned, cannot be reached by steamboats when the river is low. According to Flint, it is beautifully situated on a well-developed river bank, and extends back to a pine bluff, with fine scenery around it. I have not materials for a fuller description. The yellow fever has never, as far as I can learn, visited this town; though, according to Doctor Monotto, cases have occurred in persons arriving there from New Orleans; nor is autumnal fever very violent.

Mr. Darby† informs us that, in the neighborhood of this town, we first meet with the pecan, white-flowering locust, and red cedar, in ascending from the Gulf of Mexico.

IV. FORT JESUP.—This post, established in 1822, is situated south-west of Natchitoches, on the dividing ridge between Red River and the Sabine, about twenty-five miles from each. The surrounding forest is composed of pine, with an intermixture of oak and hickory. The surface is rolling, and somewhat rugged; the geological formation, tertiary. Along the neighboring streams there are narrow bottoms, with a dark, tenacious soil, shaded with beech, sassafras, mulberry, and cypress. Its latitude is  $31^{\circ} 30' N.$ , longitude  $93^{\circ} 47' W.$ ; its distance in a direct line from the Gulf, one hundred miles. The annual ratio of intermittent fever is twenty-four per cent.; of remittent, seven.‡ The yellow fever has not invaded it.

This is the most southern of a range of military posts lying west of, and at a distance from, the Mississippi. The others, and more northern, are Forts Towson, Smith, Gibson, Leavenworth, and Calhoun. Passing by the flourishing town of Shreveport, which I have not the means of describing, we come to

V. FORT TOWSON.—The latitude of this post is  $33^{\circ} 51' N.$ , its longitude  $95^{\circ} 1' W.$  Its site is six miles north of Red River, above the great elbow bend. The Kiamichi, a tributary of that river, passes within the same distance of the fort, to the south-east. In front of the post the ground descends gradually for a mile, when an undulating prairie, of great extent, begins. Immediately in the rear there is an abrupt descent of eighty feet into the valley, which varies in breadth from a few yards to half a mile, and is bounded on the opposite side by rolling tertiary or cretaceous hills, densely covered with oak and pine. Through this valley, which is wooded, and has a marshy surface, there flows a small tributary of Red River. The soil around the

\* Flint's Recollections.

† Statistics of Louisiana.

‡ Med. Stat., U. S. A., p. 237.



fort, composed of sand and clay, is not very productive. The annual prevalence of intermittent fever at this post is one hundred and fourteen per cent.; of remittent, twenty. It has not suffered from yellow fever.

VI. THE WASHITA.—This great tributary of Red River has acquired a notoriety which claims for it a more extended notice than I have the means of giving. Its origin is in the Ozark Mountains, there called the Washita Hills, immediately north of the great bend of Red River, a little below the latitude of thirty-four degrees. Taking at first an eastern direction, it turns at length to the south-east, and then to the south, when it descends into the Concordia Bottom (*Pl. VII*), and, under the name of Noire or Black, enters Red River about thirty miles from its mouth. Its great tributaries to the east are Saline River, joining it some distance up, and the bayous Boonf, Macon, and Tensas, which unite with it in the Mississippi bottom. On the western side it receives, nearly opposite these bayous, the Catahoola, or Little River, which has traversed Lake Catahoola; and higher up, among minor streams, the Dorbono, and Little Missouri.

Thus the upper portion of this river is in hill lands, and its middle near the junction of the hill lands with the Concordia Bottom, where it flows in such a direction that, while its right bank looks to the highlands, its left is to the bottom, into which it finally descends. Being then joined by the bayous just mentioned, it loses the character of an upland stream, and, filled with the redundant waters of the Mississippi, in spring and summer overflows its banks far and wide.

In its topography and autumnal diseases, this lower portion of the Washita is so much like the lower portions of Red River and the Mississippi, that a separate notice is not demanded; and as there is not on its banks any town of interest, we may pass to the region of its upper waters.

VII. HOT SPRINGS. —Among the upper waters of the Washita, in N. Lat. 34° 31' and W. Lon. 92° 50' 45", near the base of the south-eastern slope of the Ozark Mountains, about six miles north of the Washita River, lie the celebrated Hot Springs.\* According to Nicolle†, their elevation is seven hundred and eighteen feet above the Gulf of Mexico; the altitudes of several neighboring ridges being nine hundred and ninety-seven, eleven hundred and sixty-two, and fourteen hundred and six. The springs are about seventy in number, and burst out near each other in the same valley. In temperature, they range from ninety-two to one hundred and fifty-one of Fahrenheit. They are limpid, emit no bubbles of gas, and have no particular taste. Like many other hot springs, they hold siliceous solution; for they deposit a tufa which is composed of that earth, with lime and oxide of iron.‡ The surrounding rocks manifest more or less of a volcanic character, as I am

\* Major Long's Expedition to Rocky Mountains, Vol. II, p. 269, etc.

† Hydrograph. Basin.

‡ Expedition, *Ibid*.

inferred by Doctor Wardor, who has specimens of them in his cabinet; and according to Colonel Long, many of them are in strata highly inclined to the horizon. The scenery of this region has an aspect of wildness and grandeur, and its summer and autumnal salubrity is unquestionable.

For the people of the far south, the Washita Springs might be made an interesting summer resort, as this is their nearest mountain locality; and to invalids of the southern part of the Interior Valley whose diseases require a resort to hot springs, those of the Washita are far more convenient than the hot springs on the mountains of Virginia. If our physicians would turn the attention of their patients to this locality, the only objection—a want of comfortable accommodations—would soon be obviated.

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## SECTION V.

### THE ARKANSAS RIVER.

I. GENERAL TOPOGRAPHY.—The distant origin, in the Rocky Mountains, of this great tributary of the Mississippi, has been already given in treating of our hydrographical axes. It is, essentially, an alluvial river. In traversing the boundless plains between those mountains and the Mississippi, most of its southern tributaries, and especially Canadian River, pour in currents of salt water, colored red with the ochreous clays which belong to the rock-salt strata, while others throw in sand and blue clay. Thus, its alluvial deposits, before it reaches the Mississippi, exhibit considerable variety. Below Little Rock, craceous pine bluffs approach its right-hand bank, the bottoms on the opposite side being low and broad. At length these hills recede, and its alluvial plains blend themselves with those of the Mississippi, and abound in lakes, bayous, and swamps, which are annually replenished by the spring floods. The junction of the two rivers is about in N. Lat. 33° 40' and W. Lon. 90° 34'.

In ascending the river, after passing Little Rock, the traveler enters the range of Ozark Mountains, through which, without falls or even rapids, the river makes its way. At Fort Smith, nearly three hundred miles up, he still finds a rugged country; but at Fort Gibson, one hundred miles further, and about six hundred and thirty miles from the mouth of the river, the mountains have ceased, and the prairies, which stretch away to the Rocky Mountains, are soon on every side. That portion of the valley which traverses the hill country is much narrower than that below, and the bottoms are far less liable to inundation. The deposits which are made upon them by the freshets of the river abound in common salt, and the water which is left behind contains a great deal of that salt in solution; which, Mr. Nuttall sup-

poses, checks the progress of organic decomposition in summer and autumn, and diminishes the prevalence of intermittent and remittent fevers.\*

Of that, the longer, portion of the river which lies beyond Fort Gibson, in the great prairies, I need not speak, as its banks are almost uninhabited.

II. **LITTLE ROCK.**—Of the most important town in the valley of the Arkansas, I can say but little. Its latitude is  $34^{\circ} 45' 25''$  N.,—its elevation above the level of the Gulf, three hundred and thirty-two feet—that of Big Rock, three miles above, six hundred and eighty.† Thus the town of Little Rock is beyond the limits of the alluvial beds of the Mississippi. In fact, there are on the south side of the Arkansas a series of crataceous bluffs, below the town. On the immediate topography of this locality I cannot speak for want of facts. It has never been visited by yellow fever; and is not, I believe, greatly infested with intermittents and remittents, considering its latitude, and the contiguity of the river.

III. **FORT SMITH.**—The site of this post, in N. Lat.  $35^{\circ} 22'$ , and W. Lon.  $94^{\circ} 10'$ , is the right bank of Arkansas River, which, at that point, flows directly north. A tributary passes near the fort, on its south side, and enters the river just above it. Small lakes and marshes abound in every direction, some of which are subject to inundation from the river. The terrace on which the fort stands is about fifty feet above the alluvial plains, and consists of a dark-colored, slaty, micaceous sandstone.‡ The country beyond the bottom lands is broken, with some eminences which are almost mountainous. ||

The returns from this post indicate a decided prevalence of autumnal fever, especially the intermittent form, the annual ratio of which is one hundred and seven per cent.; that of remittents, fourteen. In the autumn of the year 1823, there prevailed a malignant fever, which put on many of the symptoms of yellow fever, of which more will be said in the history of that disease. §

IV. **FORT GIBSON.**—The latitude of this post is  $35^{\circ} 48'$  N., its longitude  $95^{\circ} 9'$  W. It is situated on the left bank of the Neosho River, a northern tributary of the Arkansas, three miles above their junction. Its site is a low bottom; and about a mile and a half to its south south-west, between the two rivers, there lies a small lake surrounded with marshes. The descent to this lake from the fort is very little, and hence the latter is badly drained. This bottom, including the place where the fort is built, was a cane-brake. Cane is found also on the opposite or south side of the river, which abounds in ponds and marshes. Immediately above the mouth of Neosho River, Verdigris Creek enters the Arkansas, and adds to the alluvial grounds on

\* Long's Expedition to the Rocky Mountains.—Nuttall's Travels in Arkansas.—Fenestonlaugh's Report and Excursion.

† Nicollet: Hydrograph. Basin.

‡ Nuttall's Travels.

|| Med. Stat. U. S. A.

§ Ibid.



the west. For three-fourths of the distance round it, this locality is environed by elevated prairies, terminating in a range of hills. As might be expected, the army reports represent this as a very sickly post in autumn—the most sickly, indeed, in the whole Interior Valley, except, perhaps, Fort Jackson, below New Orleans; the annual average being, for intermittents one hundred and twenty, for remittents, twenty-five per cent.\*

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## SECTION VI.

### THE OZARK MOUNTAINS.

In advancing by a single step through four degrees of latitude, from the Arkansas to the Missouri River, it is proper to make a few general remarks concerning the country between them. This has been already done for its eastern margin, as we ascended the Mississippi; when we saw that, from the mouth of St. Francis River to that of the Missouri, more than six hundred miles, no considerable stream enters the common trough. Of the whole, the Maramoo, below St. Louis, is the largest, but does not present anything of interest to the medical topographer.

The Arkansas, nearly as high as we ascend it, flows through the state of Arkansas; and the Missouri, in like manner, advances to the Mississippi through the state of Missouri. As we leave the right bank of the Mississippi, and advance westwardly between these rivers, we are everywhere on high, rolling, forest land; which at length rises into the Ozark Mountains, the position and outline of which were sketched in Chapter I, and may be seen on the map of the Valley. On the flanks of these mountains lie the celebrated lead, iron, and copper mines of Missouri, mostly west of Ste. Genevieve. To the south, these mountains send down branches of the River St. Francis, the whole of White River, and some small tributaries of the Arkansas, which join it above Little Rock. To the north, they throw off the Maramoo, which finally turns to the east, and unites with the Mississippi; also the Gasconade, and large branches of the Osage, which flow to the Missouri. This elevated hydrographical center of two states abounds in pure and permanent springs, is exempt from lakes and marshes, and forms a striking contrast in its topography with the broad and wet alluvial bottoms of Red River, the Washita, and Arkansas, over which we have just passed. This topographical change results from a change in the geological constitution, which is here entirely different. Loose tertiary and cretaceous deposits, easily moved about by the currents of rivers, and thus favoring the production of wide alluvial bottoms, are replaced by older and more solid strata of carboniferous and Silurian lime and sandstone, reposing upon, or around, unstratified or primitive rocks. Thus it is that mineral geology illustrates medical topography.

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\* Med. Stat. U. S. A.

Of the autumnal diseases of this region, I cannot speak with much authority; but whatever I can say, is in its favor. Beyond the western slopes of these mountains, we come to the great treeless plain, which ascends to the Rocky Mountains. It begins between the ninety-fourth and ninety-fifth degrees of west longitude, that is, not far east of the western boundary of the states of Missouri and Arkansas; and there, equidistant between the Arkansas and the Missouri, we have the interlocking sources of two of their considerable tributaries, the Neosho and Osage, which flow off nearly in opposite directions.

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## SECTION VII.

### THE MISSOURI RIVER.

I. GENERAL DESCRIPTION.—Having myself ascended the Missouri River to Fort Leavenworth, nearly four hundred miles, beyond which, from the sparseness of population, the banks at present offer but little interest to the medical topographer, I am enabled to speak with more confidence than of Red River and the Arkansas, which I did not explore.

According to Nicollet,\* the junction of the Missouri with the Mississippi, fourteen hundred and eight miles from the Gulf of Mexico, is in N. Lat.  $38^{\circ} 50' 50''$  and W. Lon.  $90^{\circ} 13' 45''$ . Its surface, at low water, is three hundred and eighty-eight feet above the Gulf. Its general course from Fort Leavenworth to its mouth is so nearly east, that the difference in latitude between the two points is only thirty-one minutes fifty seconds, and most of that difference accrues between Fort Leavenworth and the Kansas River, the mouth of which is only fifteen minutes thirteen seconds north of the junction of the Missouri with the Mississippi. The trough, or immediate valley, through which the Missouri flows, is from two to four miles wide; and bounded by rocky limestone hills, which rise to the height of from one hundred to three hundred feet. The fall in the Missouri from Fort Leavenworth to the mouth of the river, a distance of three hundred and seventy miles, is, according to Nicollet, three hundred and fifty-eight feet,—nearly a foot a mile, and within thirty feet of the entire descent afterwards to the Gulf of Mexico, a distance of fourteen hundred and eight miles.

Nearly all the Missouri bottoms are on the north or left side, the river pressing against bluffs to the south or right side; as the Mississippi, below the mouth of the Ohio, presses on its bluffs to the east or left-hand side. Most of these bottoms, in occasional extraordinary floods, like that of 1844, are liable to inundation; but ordinarily, the greater part are exempt. Ponds, lagoons, and swamps are, therefore, much less common than along the Mississippi below; and from the narrowness of the valley, they are, of course,

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\* Hydrograph. Basin.

much more limited. Another cause contributing to the same exemption, is the sandy and absorbing quality of the ground, which, along the Mississippi, is more resistant to percolation. On these bottoms, the cotton-tree takes the place of the cypress in the south.

The voyages of Lewis and Clark, and subsequently of Breckinridge, Catlin, and Nicollet, inform us, that from its remote sources in the Rocky Mountains, the Missouri flows down an inclined plain, the upper strata of which are in most places but slightly consolidated, and therefore easily disintegrated and transported. Much of it is, no doubt, a tertiary deposit, and a part is known to be cretaceous; thus giving us formations far in the interior analogous to those around the Gulf. It is in the passage of the Missouri and its great tributaries, especially the Yellow Stone and Platte, through these loose deposits, that its waters become thoroughly impregnated with all the mineral or organic substances they can either dissolve or suspend. To the suspension, the rapidity of the current greatly contributes; while, in floods, it also rolls or drifts onward various matters too heavy to be floated. These are chiefly sand and small gravel. Arriving at the limpid and delicately tinted Mississippi, it pours into the common channel its drab-colored and muddy torrents, to roll on for clarification in the Gulf of Mexico. I have already stated that a gallon of this water taken from the Mississippi opposite St. Louis, yielded one hundred and eighty grains of sediment, giving the remarkable proportion of one part by weight to three hundred and thirty-three of water.\*

Of the drifting of sand upon its banks and over its alluvial plains, I witnessed a striking example, in ascending the river after the great freshet in 1844. For about four hundred miles, there was scarcely a single plantation in the bottoms which had not suffered; and many were entirely desolated, the sand having been spread over them, in many parts near the river, to a depth of several feet. Literally, low sand-drifts occupied the very spots on which houses and fences had stood before the inundation. In places where the current had slackened, recent deposits of silt covered the surface, which, by a single inundation, was raised several inches. The great proportion of sand in these alluvial bottoms, renders them much more friable than the argillaceous banks of the Lower Mississippi; and hence they are ever falling in, and maintaining the turbidness of the stream, which meanwhile is making new deposits and new drifts; whereby its channel is perpetually changing.

The intervals or bottom lands of the Missouri are covered with a luxuriant tree and herbaceous vegetation; and as many of them are more or less submerged by the ordinary spring floods, there is no deficiency of those surface conditions which, as we have seen in so many localities, favor the production

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\* This result was ascertained by Doctor Raymond, in his analysis, given on page 75. It was, strictly, Missouri water in which Professor Bailey found so great a variety of animalcules.—See p. 71.



of autumnal fever; and there is no exemption from that epidemic. On the contrary, it prevails in the bottoms and on the bluffs every year, though the number of malignant cases is not, perhaps, as great as in more southern localities of the same topographical character.

II. **OSAGE RIVER.**—This river, the sources of which have been already indicated, after pursuing a north-east course through a rugged country, enters the Missouri by its right bank, one hundred and thirty miles from its mouth, and eight miles below the capital of the state, presently to be described. From Mr. John Johnson, who resides eighteen miles from its mouth, I learned, that the back-water of the Missouri, in 1844, ascended beyond his residence; and that the flood of the Osage itself deluged its bottoms from Warsaw down, that is, through nearly half its length. Usually, however, it does not overflow its banks. In freshets its waters are turbid, at all other times, clear, but not so remarkably limpid as those of the Gasconade, a smaller tributary of the Missouri, entering a little lower down. The latter comes entirely from the northern slopes of the Ozark Mountains. The immediate valley of Osage River varies from half a mile to a mile in width. Its inhabitants, and those of the adjacent hills, are subject to autumnal fever; but malignant cases are rare.

III. **JEFFERSON CITY**—the capital of the state of Missouri—stands on a group of right-hand bluffs, one hundred and thirty-seven miles up the river. There is no interval land in front, but on the opposite side of the river there lies a bottom of the usual width, which is liable to partial inundation from ordinary floods. Directly west of the town, a creek, which has passed near it on the south, enters the Missouri. When the river is high, the back-water ascends this little stream and submerges its narrow bottoms. The country beyond this creek, and generally around the city on the south side of the Missouri, is elevated and rugged, the hills being composed of carboniferous limestone. The buildings in the city are scattered, and none of them very old. Visiting it in the latter part of August, I had an opportunity of seeing that it is subject, in a very positive degree, to autumnal fever, chiefly intermittent. I saw, indeed, malignant or congestive cases, and found that the medical gentlemen were familiar with them. Doctor Edwards informed me, that the disease prevailed as much on the city bluffs, at an estimated height of two hundred feet, as in the bottom opposite the town; and that it was less prevalent on the margin of the bottom, than back from the river. Doctor W. Davison has observed, that the people near the creek, west of the city, both in its valley and on the adjacent hills, are more liable to fever than those farther east. He has also remarked, that the inhabitants three or four miles from the river, are more exempt than those who reside on its bluffs. Having formerly practiced medicine in the old town of Wheeling, Virginia, he was enabled to say, that his present locality was more infested with autumnal fever than the former.

IV. **BOONVILLE.**—This is another bluff-town on the same right-hand

bank of the river, fifty miles higher up, and one hundred and eighty-seven from the mouth of the Missouri. The bluffs, still composed of carboniferous limestone, are less rugged and much less elevated than those of Jefferson City; being, according to Nicollet, only seventy-two feet above low water mark, and six hundred and two above the Gulf of Mexico. The country around Boonville is dry and rolling, but on the opposite side of the river, there is a bottom two miles wide. Visiting Boonville and Jefferson City near the same time, I had an opportunity of comparing them, as to autumnal fever, and found it decidedly more prevalent at the latter, than the former. From Doctor Hart, Doctor Thomas, and Doctor Stockton, I learned, that the people who live near the La Mine, the Saline, and other smaller streams, which meander among the low hills around Boonville, are more subject to autumnal fever than those of the town and its vicinity. These streams have alluvial bottoms, of moderate width, which are partially overflowed by every freshet, or have portions of their surface converted into temporary swamps by copious rains. Many of them, moreover, are rendered stagnant by mill-dams. In a confined locality of this kind, seven or eight miles from the river, Doctor Thomas had seen many malignant and fatal intermittents. In an excursion with Doctor Stockton, five miles from town, into the valley of *Petite Saline*, which is a mile wide, flat, wet, and traversed by a stream, converted by dams into a series of ponds, I found the fever decidedly and fatally prevalent.

V. FRANKLIN, PAYETTE, AND HOWARD COUNTY.—Let us pass to the opposite side of the river. The older village of Franklin, one of the earliest settlements on the Missouri, has been arrested in its growth and partly depopulated by Boonville. The sandy and friable bottom on which it stands, or rather, on which it stood, is not only liable to overflows, but to extensive caving-in of its banks. In consequence of this, a village called New Franklin has arisen on the low bluffs in its rear. Through this village, I made an excursion of twelve miles, to the town of Payette, in Howard County. The substrata are carboniferous limestone, and the surface is low, ridgy, or rolling. A mill-stream, called the *Bonne Femme*, traverses the county from north to south, up which the back-water of the flood of 1844 ascended ten miles. Both the *Femme* and its principal branches have bottoms from a quarter to half a mile in width, which, after floods or great rains, are left wet and pondy. The town of Payette is on rolling and sufficiently dry ground. All parts of this county,—which may be taken as a specimen of the most fertile and desirable of the wood-land portions of Missouri,—are obnoxious to autumnal fever, especially near the streams. In the month of August I saw a number of cases, some of which were malignant; and Doctor Talbot, who had resided in the county several years, testified to the annual visitations, which, although general, are much more violent near the sluggish streams than elsewhere.

VI. ARROW ROCK.—This village is situated fifteen miles above Boon-

ville, and two hundred from the mouth of the river. Like the last, it stands on a level, but more elevated, rocky bluff on the right hand, and is built a little further back from the river. Opposite to it, the Missouri bottom is liable to inundation in river floods, and throughout the year abounds more or less in ponds and sloughs. In the rear of the village, on the south side of the river, at the distance of a few miles back, runs the edge of an extensive prairie. The village of Arrow Rock, according to Doctor Price, is not greatly infested with autumnal fever. The opposite bottom, and the prairies behind the village, suffer much more.

VII. MIAMI.—This new and inconsiderable village, on a locality more hilly even than Vicksburg, or any other town we have described, is found on the right bank of the river, about fifty miles above the last. The river flows against the foot of the bluffs, and presents wide and low alluvions on the north side. Indeed, for some distance before reaching this point, the bottoms are broader, more depressed, more swampy, and bear a greater resemblance to those of the Mississippi, than the bottoms lower down the Missouri. To their vicinity it is owing, perhaps, that the village of Miami, notwithstanding its rugged site, and the absence of all stagnant water near it on the south side of the river, is decidedly liable to autumnal fever. This, in fact, is not a conjecture; for, since my visit in 1844, I have been informed by Doctor Towles, that when, in summer and autumn, the wind sets over the village from that bottom, the fever inevitably appears.

VIII. SALINE COUNTY.—This is the name of the large county in which the two last-mentioned villages are situated. The Missouri here makes a great bend to the north, and hence the distance between those villages is much greater by the river than on the chord of the arc. Except a margin near the Missouri River, slips along the branches of the La Mine (which joins the Missouri above Boonville), and copses of small trees, shrubs, and vines, scattered here and there, this county is made up of undulating prairie, which, from any point, extends in all directions to the limit of vision. Many small natural ponds, and a greater number of wet prairies, generally connected with sluggish brooks, are met with. In fact, the grass materially interferes with the ready and rapid flow of the rains which fall on the prairie surface. The sub-stratum is carboniferous limestone,—the soil fertile, black, and abounding in organic matter. The prairies of Saline County are the beginning of the great plains which stretch south to the Arkansas River, and west to the Rocky Mountains; and this description may be received as applicable to their eastern margin generally. When visiting this county in 1844, I was told by Doctor Long, of the interior village of Marshall, and by Doctors Tait and Towles, of Miami, that intermittent and remittent fevers prevail in all parts of it, but do not often assume a malignant character.

IX. LEXINGTON.—The young but rapidly growing town of Lexington, like the others, stands on the south side of the river, and is two hundred and ninety-four miles from its mouth. The Missouri washes the base of the



nearly perpendicular limestone bluffs on which it is built. The elevation may be two hundred feet above the river. Immediately east of Lexington there are strata of shale, which, I presume, underlie the coal and carboniferous limestone through which we have passed from the mouth of the river; and if so, the limestone on which the town is built must be the upper Silurian. The prairies here approach within two miles of the river, and the moment we enter them, small miry and lagging rivulets, with swampy tracts, the whole having a dense covering of grass, are met with. The slip of wood-land which separates them from the river, is dry and hilly. On the north or opposite side of the Missouri, the bottom is broad, depressed, densely wooded, liable to annual inundation, and abounding in ponds and swamps, some of which are permanent. Lexington, on the whole, does not appear to be seriously infected with autumnal fever. The prairies, as in Saline County, are generally, but not violently affected. Doctor Vaughan and Doctor Vivian, of the village of Dover, near Lexington, have occasionally seen intermittents of a malignant and fatal character along the creeks up which the back-water of the Missouri flows. Doctor Flournoy and Doctor Digger, of Lexington, regard the low bottom on the opposite side of the river as more unhealthy than the town, or the adjacent prairies.

X. MOUTH OF KANSAS RIVER.—The bed of the Kansas River, near its mouth, is so level that its current, when the river is not swollen above the Missouri, is occasionally sluggish. On the upper side, its banks are high,—on the lower, there is an alluvial bottom of moderate width, which is liable to submersion. A mile below its mouth, at the foot of a bluff less elevated than that on which Lexington is built, is Westport Landing, where a number of families reside. On the opposite side of the river, there is a low and foul bottom of great extent, which is liable to inundation, and is but thinly peopled. In the month of August, I found a decided prevalence of autumnal fever among the inhabitants of Westport, both at the base and at the summits of the bluffs.

The western boundary of Missouri, from the state of Arkansas to the Missouri River, is the meridian of the mouth of the Kansas River, which is found, three hundred and seventy-two miles from the Mississippi, in Lon.  $94^{\circ} 32' 54''$  W., and Lat.  $39^{\circ} 0' 3''$  N. The low water-level of the Missouri is, at this point, seven hundred feet above the Gulf.\* The altitude of the adjoining hills may be one hundred and fifty feet higher.

XI. METHODIST MANUAL LABOR SCHOOL, AND OTHER MISSIONARY STATIONS.—These establishments are found near each other, in the Indian country, a few miles south-west of the junction of the Kansas with the Missouri. The aspect of the region which they occupy is gently rolling, with intermingled prairie and wood-land,—the former predominating. Along the small streams there are slips of grassy marsh, but no extensive swamps. Perma-

\* Fremont's First Report, p. 182, 183.

nent springs are numerous. The rocks beneath are Silurian limestone. The Baptist Mission buildings were erected on a prairie; but in 1844, when I was there, a grove of various kinds of forest trees had sprung up; apparently from the annual burning of the grass having been prevented. The number of benevolent white persons, of both sexes, attached to the two establishments which have been named, and a third under the management of the Society of Friends, has for several years been sufficient to test the autumnal salubrity of this locality; which is decidedly healthier than the bluffs at the mouth of the Kansas, or the prairies of Saline County; the former comparison showing the insalubrious influence of the river, and the latter announcing the great fact that, as we proceed westwardly on the prairies, autumnal fever becomes less and less prevalent.

XII. FORT LEAVENWORTH.—This post stands on a high limestone bluff, on the right hand side of the river, four hundred miles from its mouth, in Lat.  $39^{\circ} 22' 40''$  N., and Lon.  $94^{\circ} 44'$  W. The low water-surface of the river is seven hundred and forty-six feet above the Gulf; \* the summit of the hill on which the fort is erected, is about nine hundred feet. The river, flowing nearly south, dashes strongly against the rocks at the base of this hill. Half-way up, there breaks out a copious spring of water, the temperature of which I found to be fifty-four degrees, Fahrenheit, in the month of August. On the opposite side of the river, there is a broad and miry bottom, with all the characteristics of those further down the river. On the same side with the fort, above and below, but not very near, there are narrower bottoms. The ground stretching off to the south from Fort Leavenworth, inclines a little, and becomes undulatory. It presents both prairie and wood-land, the former greatly predominating, and becoming still more predominant as we advance westwardly. In different directions not far from the fort, I observed small tracts of grassy swamp. While this was a new post the prevalence of autumnal fever was much greater than at present, although the condition of the low bottom on the opposite side of the Missouri has not been materially changed; which shows that a part, at least, of the early sickness was owing to topographical conditions nearer the site of the fort, which have been obviated. As the dragoons stationed here often spent a portion of the summer and autumn in excursions on the prairies, the returns do not admit of an accurate estimate of the ratios of intermittent and remittent fevers.

XIII. SETTLEMENTS NORTH OF THE MISSOURI RIVER.—These settlements belong either to the state of Missouri, which extends up to the latitude of forty degrees thirty minutes, or to the southern or south-eastern part of Iowa, which rests upon that parallel. The former were made first; but all are comparatively new. The principal river of this region,

\* Nicolle: Hydrograph. Basin.

belonging chiefly to Iowa, is the Des Moines, which originates on the Coteau des Prairies, between the St. Peter's and the Missouri, and flows nearly to the south-east, until it reaches the Mississippi.

Within the state of Missouri the population of this region is chiefly found in the little basins of Salt River, which flows into the Mississippi, and of the Chariton, the Grand, and the Little Platte Rivers, which empty into the Missouri. Of this region, I can say but little. It presents a mixture of wood-land and prairie, the latter increasing as we advance from the Missouri or Mississippi; the surface is either flat or undulating; the rivers have wide bottoms; and intermittent and remittent fevers are annual epidemics. When describing Boonville, some account was given of Howard County lying within this region.

The principal rivers of south-eastern Iowa (after the Des Moines) are the Shikagon, Iowa, Wabozipinkau, and Makokety. As far as is known to me, the country through which they flow, is in the main similar to northern Missouri, with less autumnal fever, because in higher latitudes.

XIV. THE GREAT PLAINS—THE INDIAN COUNTRY.—If the reader will turn to the map of the Interior Valley (Pl. I), he may, by the descriptions in this chapter, trace the boundary line of the Caucasian and Indian populations. To do this, he must descend from Santa Fe, in N. Lat.  $35^{\circ} 41'$  and W. Lon.  $106^{\circ}$ , keeping on the east side of the Rio del Norte, until he comes to the back settlements of Texas, about latitude thirty-three; then turn eastwardly to the state of Arkansas; then ascend on the ninety-fourth meridian to the mouth of the Kansas; then go up the Missouri River to the northern boundary of the state of Missouri, in Lat.  $40^{\circ} 30'$ ; and then travel north-north-east to the junction of the St. Peter's with the Mississippi, in N. Lat.  $44^{\circ} 52' 46''$  and W. Lon.  $93^{\circ} 4' 54''$ . In following such a line, he will have a Europeo-American population to his right, and an Indian population to his left. Having done this, and cast his eyes on the Appalachian Mountains to the east and the Rocky Mountains to the west, he will at once perceive the vastness of the savannas which are still in the joint occupancy of migratory herds of buffaloes, and the savage tribes which follow on their trails. The natural characteristics of this boundless region may (as far as etiology is interested) be sketched in a few sentences. It extends through fifteen degrees of latitude; rises regularly from south-east to north-west until it reaches the base of the Rocky Mountains; has but little forest, except along its streams; consists, at and near its surface, of sand and other loose matters, which largely imbibes its rivers; enjoys but little rain, compared with the more eastern part of the Valley; from the dryness of the surface and the absence of trees, often becomes greatly heated in summer; from its declivity, its destitution of forest, and its contiguity to the Rocky Mountains, experiences unwonted coldness in winter; and finally, suffers extensive running fires, when its grass has dried in autumn.

Such a region, except near the rivers which traverse its lower latitudes,



can never be much infested with intermittent and remittent fevers; but it may be scourged with the phlegmasia of the lungs and joints. Its summer health is likely to be greater than its winter.

XV. JOURNEYS OF HEALTH ON THE GREAT PLAINS.—There are three routes by which invalids may traverse the plains.

*First. The Missouri Route.*—The Missouri is the only river of the entire region that will admit of steamboat navigation. The opportunity for making a distant voyage on this river does not often occur, and when it does, it should not be preferred to the others, by any who have health and strength to travel by land. The voyage, when made, is always for the purposes of trade, and is sometimes limited to the Council Bluffs, the site of the vacated Fort Calhoun, eight hundred miles from St. Louis; at others, extended to Fort Pierre Chouteau, a fur-trading establishment, five hundred miles further, above the forty-fourth degree of north latitude, and at a low-water river-elevation of fourteen hundred and fifty-six feet over the Gulf, or nearly eleven hundred feet above the Mississippi at St. Louis. Such changes of latitude and elevation must necessarily give a pleasant and invigorating summer climate to southern invalids, the effects of which will be heightened by the novelty and wildness of the scenery. The slow progress of the boat against the rapid current of the Missouri in ascending, and the frequent obstacles and stoppages, should be regarded as recommendations, and not objections, to the voyage; as they would afford opportunities for exercise or amusement on shore.

*Second. The over-land route to Oregon.*—This road leaves the Missouri at or below the mouth of the Kansas; ascends the valley of that river for some distance; then turns north of west to the Nebraska or Big Platte, and, traversing the Black Hills, makes its way to the South Pass of the Rocky Mountains. In making a summer journey on this route, as there is not much northing, and very limited forests, the heat may be oppressive, until a high altitude is attained; but fevers need not be apprehended. After passing the hundredth meridian, the dews are so inconsiderable, that but little inconvenience is felt from lodging on the grass, even without a tent. Excursions of health, science, and pleasure united, might be made by parties, to the distance of several hundred miles; where, in the voiceless solitudes of the desert, they might pitch their tents, and plunge into rustication. Invalids, moreover, might attach themselves to companies of emigrants bound for Oregon or Upper California; returning home as opportunities might offer. In such journeys they would find that radically curative and reinvigorating influence which short excursions cannot, of course, impart.

*Third. The route to Santa Fé.*—Of the three routes this is, and for a long time will continue to be, the most traveled. Bearing a little to the south of west, it does not give the advantage of as cool a climate as the others; but the surface which is traveled over does not generate autumnal fevers. Moreover, this route may be pursued at a later period in autumn than

either of the others. Another recommendation is, that the distance is not so great as that to Oregon; and yet, after reaching Santa Fé, he has it in his power to prolong his journey, by descending the valley of the Rio del Norte to the luscious vineyards of the El Paso; or he may ascend to the rich and beautiful valley of Taos; and thence scale the surrounding outliers of the Rocky Mountains. His elevation, while sojourning in these valleys, will be from five to seven thousand feet above the Gulf—quite equal to that of the *Tierras Templadas*, or temperate countries of Mexico; in addition to which, the snowy summits of the neighboring mountains will often refresh him with cool and strength-giving breezes of pure air.

From a deep conviction of the value of these overland journeys to several classes of valotudinarians, I am constrained to point out some of the various modes in which they operate: 1. The patient escapes from that malaria, or that condition of the atmosphere, which, in the larger portions of the Great Valley, gives origin to intermittent and remittent fevers, too often followed by infirmities for which a change of locality is the only effectual remedy. 2. He is constantly immersed in a dryer air. 3. He lodges on a hard bed. 4. He lives on a reduced, solid, and simple diet. 5. He drinks water. 6. He takes regular saddle exercise, or relieves himself by walking. 7. His eye and mind are constantly exercised, on objects which stand in contrast with those he has left behind. 8. He is divested of his old cares; and his new ones, although constant realities, are few in number. 9. He is redeemed from the dominion of empiricism and polypharmacy. Such are the therapeutics of these journeys; and to what infirmities are they applicable? Every enlightened physician will answer: 1. To all forms of dyspepsia, even that depending on chronic gastritis. 2. To chronic disorders of the liver, spleen, and bowels. 3. To morbid sensibility and morbid imagination,—including every shade of hysteria and hypochondriasis. 4. To apoplexy in its incipiently-forming stage, and to lingering and partial palsies, following its attack. 5. To hæmoptysis, depending on plethora or hæmorrhagic diathesis. 6. To tubercular consumption in every stage, from the earliest predisposition to that in which the patient has merely the ability to keep in his saddle through the day.

But it may be said, these journeys abound in exposures, fatigues, and privations. Undoubtedly they do; and it is on them that the benefit chiefly depends. Take them away, and a journey over the desert to the Rocky Mountains would be scarcely more efficacious than the fashionable voyage to Europe.

## CHAPTER VIII.

## THE SOUTHERN BASIN, CONTINUED.

## MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE GULF AND THE MISSISSIPPI, AND SOUTH OF THE OHIO BASIN.

## SECTION I.

## GEOGRAPHICAL AND GEOLOGICAL OUTLINES.

I. LIMITS.—The region on which we now enter, comprises the western side of Florida, the western margin of Georgia, nearly the whole of Alabama, a portion of East Louisiana, the entire state of Mississippi, and the west end of Tennessee. It is in fact a large section of the Great Valley, and presents to the medical topographer subjects of the gravest interest.

II. HILL COUNTRY—OLD GEOLOGICAL FORMATIONS.—The north-eastern portions of this region, in Georgia, Alabama, and Mississippi, are mountainous or hilly, being the extreme southern termination of the Appalachian chain, turned westwardly toward the Mississippi River. From these highlands, streams pour down to the Tennessee River, to be discharged, by a circuitous course, into the Ohio, while others, larger and more numerous, flow directly to the Gulf. That portion of this water-shed which lies within the state of Georgia and the adjoining eastern side of Alabama, is composed of primitive rocks; while further west, through the latter state, into Mississippi, the rock formations consist of the older secondary or Silurian limestones, and of the sandstones and shales which belong to the superincumbent coal formation. On the Coosa River, as far down as Wetumpka, primitive rocks, in the form of gneiss and mica slate, show themselves; and at Tuscaloosa, the late capital of Alabama, on the Tuscaloosa or Black Warrior River, and on the Catawba, above Centreville, coal makes its appearance at the surface.

III. THE CRETACEOUS FORMATION.—Immediately south and west of these formations, and sweeping round from Georgia to West Tennessee, we have the larger portion of the most extensive cretaceous formation which exists anywhere (as far as we yet know) in the Great Valley, or indeed on the continent of North America. The western portion of this formation, lying beyond the Mississippi River, and traversed by the Washita and Arkansas, has been already noticed. The Mississippi cuts through this formation (which con-



attitudes its bluffs), from the western extremity of Kentucky, to a line not far above Vicksburg in the state of Mississippi. In addition to the Mississippi, it is traversed by the Yazoo and Big Black, tributaries of that river; and further east, by Pearl River, the Tombigbee, Tuscaloosa, Cahawba, Coosa, Tallapoosa, Chattahoochee, and Flint Rivers, the last two of which, by their union, form the Appalachicola. As the strata of the cretaceous formation dip to the south, these various rivers traverse them at right angles to their lines of bearing. The general surface of this cretaceous formation, near its northern margin, is hilly; further south, and in the neighborhood of the rivers, it is somewhat rugged, with extensive intervening plains, or table lands, from which the water, in many places, runs off with difficulty; and hence sluggish and swampy streams are not uncommon. As the strata are soft, the rivers, both small and large, have formed wide valleys, most of which are subject to inundation. Although the rocks, geologically speaking, belong to the cretaceous formation, no chalk has yet been discovered. The chief deposits are calcareous, and called by the people 'rotten limestone.' They consist of an argillaceous, friable carbonate of lime; but there are, likewise, soft sandstone, and strata of clay, sand, and gravel, of which some details may be given hereafter. Where the last two are at the surface, the rains percolate into the earth, and form permanent springs of pure, soft water; but where the rotten limestone shows itself at the surface, as it is free from fissures, and impervious to water, the springs are few, superficial, and transient.

Beginning at the east, the principal towns in the cretaceous formation are, Columbus, Georgia, on the left bank of the Chattahoochee River; Montgomery, the now capital of Alabama; Wetumpka, Selma, Cahawba, Marion, Greensboro, Demopolis, Eutaw, Tuscaloosa, and Pickensville, in Alabama; Columbus, Yazoo, Pontotoc, and Holly Springs, in Mississippi; and Memphis, Randolph, Somerville, and Bolivar, in Tennessee. The whole of the cretaceous formation is infested with autumnal fever, beyond, perhaps, any other portion of the Great Valley; but yellow fever has only occurred at Memphis, on the Mississippi River.

IV. THE TERTIARY, POST-TERTIARY, DILUVIAL, AND ALLUVIAL DEPOSITS. — Advancing southerly from the cretaceous formation, we come upon the newer deposits, which extend to the Gulf of Mexico, where we have already contemplated their southern margin. These strata, which constitute the newest geological beds, are still less consolidated than the cretaceous, on which they repose. The coceno, or oldest, crop out with a line of bearing from the Chattahoochee River, to, or beyond, the Tombigbee, and form the high bluffs of the Alabama River, at Chiborno.\* This formation, which has no great width, is calcareous, and, like its mineral analogues of the cretaceous group, has a dip to the south or south south-west. To this suc-

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\* Conrad.

ceed the newer tertiary and post-tertiary deposits of loam, gravel, and sand, not yet consolidated into rock. As a general fact, the surface of the tertiary region, from Florida round to the Mississippi River, is flatter, and lies at a lower level, than the cretaceous. Its fertility is less, and its inhabitants fewer, but most of it is better watered. The same rivers traverse both regions, requiring broader alluvial bottoms as they flow on to the Gulf. Much of this extensive plateau has a dry and sandy surface; but, on the other hand, much of it near the streams is swampy. Its principal towns, off the Gulf coast, are Tallahassee, in Middle Florida; Claiborne, in Alabama; Jackson, Vicksburg, and Natchez, in Mississippi; and Baton Rouge, the capital of Louisiana.

Like the cretaceous formation, all the fertile parts of this region are subject to autumnal fever of a violent character; and, as we have seen, the towns on the Mississippi have been often visited by yellow fever. The most populous portions of the cretaceous and tertiary regions here sketched out, lie between the parallels of thirty-one and thirty-three degrees north.

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## SECTION II.

### THE COUNTRY EAST AND SOUTH OF APPALACHICOLA BAY AND RIVER.

I. GENERAL VIEWS.—We are indebted to the Army Surgeons and Topographical Engineers who served in this region during the Seminole war, for most that we know of its medical topography, as the greater part of it is uninhabited, or but thinly peopled.\* When at Pensacola in 1848, I could not obtain facilities for visiting it. The low water-shed which divides the streams that flow into the Gulf of Mexico, from those which make their way, eastwardly, into the Atlantic Ocean, subsides entirely before it reaches the twenty-eighth degree of latitude; that is, about the middle of the peninsula. Thence to Cape Sable the surface is but little elevated above the sea, and has no particular inclination. Consequently, it is overspread by savannas, swamps, immense grassy ponds, and small lakes, to a degree that must forever render most of it uninhabitable. It is called the Everglades. Above the twenty-eighth parallel, where the water-shed emerges from the dead level, the map discloses, that the number of lakes on its eastern side is much greater than on its western, or that portion which lies within the Mexican Basin, and is traversed by the Hillsboro, Withlacoochee, Santa Fe, Suwanee, and some smaller rivers. According to Doctor Forry:

“This northern portion is an extensive pine forest, interspersed with ponds, swamps, low savannas, and hummocks, which last are rich bottoms overgrown

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\* Medical Statistics U. S. Army.—Forry on the Climate of the United States.—Map of the Seat of War in Florida, by Captain Mackay and Lieutenant Blake, United States Topographical Engineers.

with trees, and a redundant under-wood. The barrens are covered with forests of pine, with little under-growth. The soil consists mostly of sand; but the hummocks, which are numerous, have a fertile soil composed of clay and sand. The savannas, which are covered with a tall grass, are inundated during the wet season. The river swamps are wooded with a variety of heavy trees, whilst the pine-barren swamps are mostly overgrown with cypress and cypress-knees."\*

The dry pine lands are composed mostly of silicious sand, more or less fertilized with carbonate of lime and vegetable mold. The swamps on the borders of the rivers are formed by the inundations, which deposit alluvion on their banks, and thus dam out a portion of the returning waters.

The sub-stratum of this region, and of the peninsula of Florida generally, is rotten limestone—cretaceous or tertiary; but it differs from that of Alabama, in being cavernous; and hence many of the smaller streams disappear from the surface, and reappear in the form of copious springs. Small lakes, likewise, occasionally empty themselves through unseen fissures in their beds; and many of the tracts denominated hummocks seem to have been laid bare in this manner. We must now take notice of some localities.

II. **FORT KING.**—The site of this military post is not positively within the Mexican Basin, for the copious spring of pure water which originates near it, flows to the east. There are reasons, however, for claiming it as belonging to that basin, and no valid geographical objection, seeing that it stands on the dividing ridge which makes the eastern boundary of the basin.

"As regards geographical position, this station is about ninety-five miles north-east of the head of Tampa Bay, one hundred and thirty south-west of St. Augustine, perhaps forty miles due east from the Gulf of Mexico, and sixty due west from the Atlantic Ocean. The fort, which has been recently rebuilt, is situated on rising ground, partially encompassed by a hummock, which describes almost a semi-circle, at an average distance of five hundred yards from the pickets. The surface of the surrounding country is slightly undulating. The soil of the so-called *pine barren* consists of loose sand and a light admixture of vegetable mold, with an argillaceous sub-stratum. Its principal vegetable productions are, the pitch pine (*Pinus rigida*), black jack (*Quercus nigra*), scrub oak (*Quercus catesbeii*), palmetto (*Chumarpops*), and coarse herbaceous plants. The *hummocks* are rich, marshy bottoms, composed of vegetable deposition, overgrown with redundant vegetation. Here flourish the live-oak, with other species of the same genus, the cypress, magnolia, cabbage-tree, and several varieties of hickory (*Carya*), all united by a cordage of vines and brambles, extending from trunk to trunk and from limb to limb, constituting an immense net-work of vegetation.

"No large bodies of water exist in the vicinity of this post. Three miles

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\* Climate of the United States, p. 193.



from this point is Silver Spring, the source of a beautiful stream of the same name. From this fountain, remarkable for its transparency, Silver Creek emerges at once a bold stream, sixty yards wide and twenty feet deep, running into the Ocklawaha about twelve miles from this post.

"Although large bodies of water do not exist in the vicinity, yet the actual quantity is very great, owing to the extensive marshy low-lands, swamps, and stagnant pools; and as the soil is not completely covered with water, the circumstances most conducive to the evolution of those morbid agents resulting from solar influence, obtain. The humidity of the vicinal hummocks gives rise to constant exhalations, which fall in heavy dews."\*

The annual ratio of intermittent fever at this post, as deduced from the returns of four years, is one hundred and twenty-three per cent.; of remittent, twenty. These ratios are decidedly high.

"This post, however, has always been regarded as decidedly salubrious, with the exception of the liability to fever and ague. Violent fevers of the remittent form, and intermittents running into the same type, occurred in the latter part of the summer of 1837, owing, doubtless, to the circumstance that the smaller trees and under-growth of a neighboring hummock had been cut down, as a precaution against Indian ambuscado. It is a well-known fact that military stations, near jungles, often continue healthy until the soil is brought under cultivation, or the trees and shrubbery cut down, exposing the boggy surface to the agency of solar action."†

When adequate settlements shall be made at Fort King, it will perhaps become an important place of winter resort for invalids. Lying nearly a degree south of St. Augustine, and more than a degree south of Pensacola, it must have a warmer winter climate than either; and being nearly equidistant from the Atlantic Ocean and the Gulf of Mexico, on the shores of which those resorts for invalids are, respectively, situated, it has an equal advantage as to diminution of atmospheric moisture and the absence of a mixture of land and sea airs.

III. Except Fort Brooke and Fort King, nearly all the posts of Florida were temporary, and their topography has not been published. I can give the following memorandums of two or three others, from conversation with Assistant Surgeon Holmes, who served at each of them.

1. *Fort Wacusassa*.—This post was situated about thirty miles from the Gulf, on the head waters of a small river which enters it between the Withlacoochee and Suwanee. Its site was the edge of a wet prairie, and yet it was regarded as one of the healthiest posts in Florida.

2. *Fort White* was erected on the left bank of the Santa Fe River, about eighteen miles from its junction with the Suwanee. On the opposite side of the river (which is forty yards wide) there is a cypress swamp. The

\* Climate of the United States, pp. 212-13.

† Med. Stat. U. S. A., p. 295.

rocks beneath are rotten limestone, with good springs. Autumnal fever, in all its varieties, was common.

3. *Fort McComb.*—The Suwanee River, one of the largest in Florida, has its origin in the vast Okefenokee swamp, extending from the thirty-first to the thirty-second degree of north latitude. On its way to the Gulf it is joined by the Santa Fé, just mentioned, below which its wide, swampy bottoms are overshadowed by moss-lunged cypress trees, loftier than Doctor Holmes saw anywhere else in Florida. Fort McComb is situated on the right side of this river, a considerable distance from the Gulf, about Lat.  $30^{\circ}$  N. The banks are rocky and sandy; the surface of the plain is white sand, with a sub-stratum of clay a foot beneath. There are no swamps nor drowned lands near this post; yet it is infested with autumnal fever.

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### SECTION III.

#### BASIN OF THE APPALACHICOLA RIVER.

I. *The River.*—This considerable river extends from the southern bend of the Appalachian Mountains, directly south to the Gulf of Mexico. It is the most eastern river of this part of the Great Valley. Its upper portion, under the name of Chattahoochee, flows through the primitive formations,—its lower half traverses the cretaceous and tertiary. It drains the western part of Georgia, the eastern of Alabama, and, to some extent, the northern of Florida.

II. *Fort Mitchell.*—This, now ungarrisoned, post was situated ten miles below the town of Columbus, on the right or west bank of the Chattahoochee River, in N. Lat.  $32^{\circ} 10'$  and W. Lon.  $85^{\circ} 10'$ . It occupies an elevated ridge about one mile from the river. Between it and the river the bottom is low, but nearly free from marshes. In reference to autumnal fever, it was found remarkably salubrious; the annual ratio of intermittents being only thirteen per cent.; of remittents, eight per cent.\*

III. *Columbus.*—I am indebted to Doctor Charles A. Hentz, for a description of the medical topography of this place. It stands on the left or eastern bank of the Chattahoochee River, which, for a long distance, makes the dividing line between Georgia and Alabama, in N. Lat. (about)  $32^{\circ} 25'$ , and W. Lon. near  $85^{\circ} 10'$ . Geologically, it is found at the junction of the cretaceous formation with the primitive. Opposite to, and above, the upper or northern part of the town, there are rapids, and the river-bed abounds in masses of granite and other primitive rocks, which are more or less grouped into small islands. In some places these rocks have become decomposed into beds of kaolin, out of which a dentist of the town, by the aid of his blow-

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\* Medical Stat. U. S. A.

pipe, has made artificial teeth. The rapids at this place render a higher ascent of the river by steamboats impracticable. Within a mile of their foot, there are two mill-dams; but the declivity on which they stand prevents the formation of extensive ponds. No portion of the river-bottom on either side is subject to inundation. "The town-site is a smooth plain, elevated about fifty feet above the surface of the river, that elevation being reached by two ascents;—the first bluff is thirty feet high, with a plain five hundred feet in breadth, in its rear;—the second bluff is twenty feet higher, and spreads out into the margin a much broader terrace, on which the town is chiefly built. The two terraces are a mile in breadth. Then comes a third rise of about one hundred feet, to a plateau a mile broad, beyond which there is a creek, with low, marshy bottoms, appropriated to the growing of rice."

The gutters of the second terrace discharge their waters into an artificial drain, with which some rivulets, originating near the north-east corner of the town, have been united. The depression of the plain through which this drainage takes place, presents sloughs and ponds, some of which are dried up in summer. A little further to the east, is a larger stream, with tracts of wood-land swamp. These bad topographical conditions happily lie to the leeward of the town; but on the opposite or western side of the river, there are sources of autumnal fever which lie to the windward. On that bank we have the village of Girard, through which Marshall's Creek makes its way to the Chattahoochee. Within the village it is extremely tortuous; at the distance of one and two miles from its mouth, there are two mill-dams with foul ponds; and immediately below the first, there is a belt of alluvial marsh. The inhabitants drink water, introduced by a hydrant system, from a neighboring spring. Autumnal fever is the chief object of medical practice in Columbus. It prevails most in the south-east part of the city, in the neighborhood of the drain, and of the wet or pondy tract through which it runs. The fever displays every type and grade of violence. On the Alabama side, along the high banks of Marshall's Creek, its prevalence is still more certain and dangerous. Yellow fever has not occurred in this locality.

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## SECTION IV.

### Basin of the Alabama River.

I. **THE RIVER.**—It has been already stated that this river is composed of the Coosa and Tallapoosa, which, after their junction, assume a common name. As it descends to the south, it is reinforced, through its right bank, by the Cahawba; but the number of its tributaries is small. Before reaching the head of Mobile Bay it unites with the Tombigbee, and assumes the name of Mobile River. Here commences the long estuary—briefly described on page 54—which extends down to the city of Mobile. The



settlements along this estuary are comparatively few, and they are infested with severe autumnal fevers. Near its termination in the bay, on the left-hand side, is the blighted village of Blakely, which has suffered, once or oftener, from yellow fever. That disease, however, has not, I believe, yet advanced further up the estuary.

After leaving the highlands, the Alabama River flows through loose cretaceous and tertiary strata, in which it could not fail to excavate a wide valley. Its banks become more developed as we advance upward. Like other streams which meander in alluvial valleys, it generally presents a bluff on one side, and a low bottom, subject to annual inundation, on the other. In many places the bottom is from two to three miles wide; and, where not subjected to cultivation, presents forests of cane, cypress, sweet-gum, sycamore, cotton-wood, magnolia, and live-oak, with an iron-gray drapery of long moss. The face of the bluffs is generally wooded with the same trees, except the cypress. On their summits the forest becomes piny. Those summits, in the form of plateaus, stretch off from the river, indefinitely, on both sides, and abound in swamps, the tree and herbaceous vegetation of which is not unlike that of the bottoms, while the dryer and sandier portions are overshadowed with interspersed pines and oaks.

As the river, descending from the north, strikes against the out-cropping edges of the strata, through which it cuts at right angles to their line of bearing, the medical geologist, on the upward voyage, has an opportunity of becoming acquainted with the mineral character of the superficial parts of the region which he traverses. At first, he sees beds of tertiary clay and loam, which present shades of blue, red, and yellow; then comes, at Claiborne, the bold out-crop of old or coeene tertiary limestone, more solid, and, therefore, less disposed to crumble away, than the looser strata which overlie it; to the limestone succeed, as we advance, beds of sand, loam, gravel, lignite, and shale, inclosing geodes, which are arranged in strata. Further up, are new and much thicker deposits of loose reddish clay and sand; then follow high banks of coarse friable rocks, sand, dull red and blue clays, and rolled pebbles, consolidated into breccia or pudding-stone, the stratification being waved, oblique, and extremely irregular, but on the whole affecting a horizontal position. In low situations, a soft, bluish, cretaceous limestone now shows itself, and the surface of the country becomes more rugged. In this enumeration, no reference is made to the line of division between the tertiary and cretaceous groups of the geologists, which are characterized by different organic remains; nor is it necessary, for the medical etiologist is only interested in the mineral constitution of the rocks which underlie or constitute the surfaces which he studies.

But little of the bottom-land of the Alabama River has been reclaimed; and much of it is subject to such deep inundations that its cultivation is impracticable. It would seem scarcely necessary to say, that the inhabitants near such a stream, in the latitudes of thirty-two and thirty-three degrees

north, are subject to the worst forms of autumnal fever. Those who reside at the water's edge, with a swamp between them and the distant bluffs, are said to be less liable than those who live on the bluffs; but the population visible from the river is sparse; for experience has shown the necessity of placing families in the pine woods, at the distance of one, two, or three miles from the river.

But few towns of any considerable size adorn the banks of Alabama River. Those which I am about to describe are the most important, and their topography will serve, in some degree, to fill up the meager outline which has been sketched.

II. CLAIRBORNE.—This was originally a military post. It is situated on a very high bluff, on the left side of Alabama River, not far above its junction with the Tombekbee, in N. Lat.  $31^{\circ} 30'$ . It stands on the cocone or oldest tertiary calcareous rock. According to Doctor Lewis, the plain inclines back from the brow of the bluff until it terminates in a few low marshy ponds.\* On the opposite side of the river, there is a depressed and swampy bottom. Claiborne is subject to severe autumnal fevers of every form and grade; but has not, I believe, suffered from yellow fever.

III. CAHAWBA: RIVER AND TOWN. *The River.*—It has been already mentioned, that Cahawba River is the largest tributary of the Alabama. Its origin is in the highlands, between the Coosa and Tusculloosa, whence it descends into the cretaceous formation, within which it has wide bottoms, subject to annual inundation. It joins itself to the Alabama, while still in that formation, a little above the thirty-second degree of north latitude. Immediately below its junction, which is through the right or west bank of that river, stands

*The Town.*—In 1831, the late respectable Doctor Heustis published an instructive paper on this locality,† and in 1843, I paid it a short visit. The plain on which the town is built consists of red and yellow loam, sand, and pebbles, which repose on strata of bluish rotten or cretaceous limestone or marlite, which shows itself in the river bank, between high and low water-marks. The elevation of the site is not such as to preserve it from inundation when the river rises to its greatest height; and at such times the grounds above the mouth of Cahawba River are likewise overflowed. On several parts of it there were ponds, which have been drained. To its north-west, extending from one river to the other, there is, as Doctor English and Doctor Morrell informed me, a liquidambar swamp, about a mile and a half in width, the margin of which is three miles from town. On the opposite side of the Alabama River, to the east, the plain is elevated and sandy, but includes a few ponds. Cahawba is the seat of justice of Dallas county, concerning which Doctor Heustis, in the paper referred to, speaks as follows:

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\* New Orleans Journal, Vol. III, No. 6.

† American Journal, May, 1831, p. 75.

"There is in this county a very considerable proportion of fertile land, confined principally to the rivers, creeks, and prairies. The upland in other situations is generally thin and sandy, yet when of moderate fertility, it is often preferred, on account of the purity of the water and healthfulness of situation, to the less salubrious though more productive lands near the rivers. Perhaps there is no country possessing a greater variety of soil, and in which sudden changes take place more frequently from fertile to poor, and *vice versa*; or, in common parlance, where the land is more spotted: not unfrequently a space or strip of a few yards constituting the boundary between lands of very poor and of very rich quality. It would seem that, with the exception of the more recently formed rich river-lands, this great and sudden variation in the soil is owing, in a considerable degree, to the depth or proximity to the surface of the subjacent limestone. There can be little doubt that this limestone possesses the property of great fertility.

"The land, not only of this county but also of most others in the state, may be divided into six natural varieties, or classes. First, the side river-bottoms, or swamps, as they are called, subject to inundations. Second, the more elevated river-lands, of inferior quality, and not subject to overflow. Third, hummock, or second river and creek-bottom, or low grounds of a loose, black, sandy soil, fertile, and above inundation. Fourth, first quality of upland, of intermediate fertility between the hummock and second quality of upland. Fifth, second quality of upland, consisting principally of pine woods, interspersed with a few oaks, hickories, &c. Sixth, prairie. The extent of the first division, or river-bottom, is extremely various and irregular, being sometimes a mere border, of not more than forty or fifty yards in width, and in other places extending from one to two miles from the river; and in other situations again, the second quality of upland or pine woods, reaches to the very river, forming high and precipitous bluffs. Generally, where one bank of the river or creek is formed in this manner, the opposite one is low, with a greater or less extent of rich river or creek-bottom. Before, and at the first settlement of this country by the present white population, the rich river-lands were thickly covered with gigantic cane; this, since that time, has, in many places, been entirely destroyed by accidental fires, and by cattle, which are extremely fond of it, especially when young and succulent, at which time they eagerly devour the whole plant. Thus, when the old cane dies, as it does spontaneously in a few years, after going to seed, as none of younger growth has been left to succeed, the crop is entirely destroyed. There is, however, in this state, a considerable proportion of cane land remote from the rivers and creeks. It is scarcely necessary to say, that land of this description is of the first quality. When the growth of cane is not situated on the rivers and creeks, or, in other words, where the soil which produces it is not *made land*, the result of alluvion and inundation, it is of prairie or limestone quality."

Both Cahawba and the surrounding country have, from the beginning of



their settlement, been subject to violent and often fatal intermittent and remittent fevers; but, with the progress of cultivation, the severity of these diseases has been considerably mitigated.

IV. MARION.—We must diverge from the bed of the Alabama River, to say something of a town situated on the waters of the Cahawba. Marion is the principal town of Perry county, which adjoins Dallas county on the north. The streams which originate around it, flow partly into the Cahawba, and in part into the Tuscaloosa. Its site is uneven, and the ground slopes in all directions from it. The general surface of the country around it is dry and moderately fertile, with scattering pines. Sloughs and marshes are few in number, and the streams flow with greater velocity than in many other parts of South Alabama. The surface, much of which presents reddish, sandy loam, is undulating. From the best information I could obtain, the autumnal health of Marion is in harmony with its favorable topography. Mr. Jowett, the teacher of one of the female academies, with his assistants, averaging seven persons in the family, all from the north, had resided here four years, without one attack of autumnal fever.

V. SELMA.—The position of this town is ten miles above Cahawba, on the right bank of Alabama River. Its site is an elevated sandy plain, presenting bluffs, washed by the river; which, on reaching the town, has flowed from the south-east, to bend soon afterwards to the south-west. The plain, covered with oaks and scattering pines, is free from ponds and marshes. To the north and east of the town, however, at the distance of two or three miles, there is an extensive swamp. Soft and good water is obtained on the town plat, by digging twenty or thirty feet. From a comparison of all the information I could collect, at this place and Cahawba, concerning autumnal fever, I am brought to the conclusion, that the disease prevails less here than there; which might be expected from the differences in their topography. It has not been visited by yellow fever.

In a late paper by Doctor Harris, on the Medical Topography of South Alabama, I find the following paragraph:

"In 1824, the yellow fever appeared in Selma, and that section of the country known as the Pleasant Valley, ten or twelve miles north; one case under Doctor Phillips terminated fatally on the third day after black vomit, and several cases under my inspection on the fifth and seventh days after the same, some in collapse. There was no yellow fever in Mobile at the time."\*

It is remarkable that Doctor Heustis, in his paper on the Diseases of Cahawba, is silent as to this alleged yellow fever; and that Doctor Lewis, in his Medical History of Alabama, has not adverted to it; and equally remarkable that, in the course of a rigid inquiry, in 1843, into the fevers of that region, not one of its numerous physicians should have mentioned to me

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\* West. Jour. of Med. and Sur., (Louisville), December, 1846.

what Doctor Harris has since published. In the history of our yellow fever, this statement will again come under review.

VI. MONTGOMERY.—This city has lately been made the permanent capital of the state of Alabama; and being both the most populous, and the largest cotton-shipping town of the interior of the state, it merits a more extended notice than has been bestowed upon Selma. The position of Montgomery, on the left bank of Alabama River, four hundred miles from Mobile, in N. Lat.  $32^{\circ} 10'$  and W. Lon.  $86^{\circ} 12'$ , is on the convexity of a compressed horse-shoe bend. Thus, in approaching the city, the river flows *from* the north north-west, and, in departing, flows *to* the north-west; folding on itself in a remarkable manner, and forming, opposite to, and north-west of, the city, a low, long, heavily-timbered peninsula, which is too liable to deep inundations to be cultivated, except in a few spots.

The immediate site of the city is a terrace, above high water-mark, with an amphitheatre of hill-land, or bluff, more than one hundred feet high, in its rear, and extending from the east round to south-west. The surface of the plain on which the city is chiefly built, is sandy; and, at the beginning of its settlement, had some ponds, which have been since filled up. The streets are unpaved, and but indifferently shaded. On the plain to the north-east of the city, there are numerous ponds and marshes, which are thrown into forms more or less elongated and serpentine, by oak and pine ridges or narrow plateaus, which gradually become more elevated and hill-like, but still embosomed stagnant and swampy streams. The upper stratum of this tract is a red, sandy loam, with beds of silicious gravel. To the west north-west of the city, there is a margin of lower and wetter bottom-land, on the upper end of which attempts were once made to build a town, but it proved too insalubrious. In the rear of this bottom, a plateau, as elevated as the site of the city, begins, and stretches westwardly to the junction of Catoma Creek with the river, eight or ten miles below. The predominant growth of this plain is oak. It abounds in ponds and marshes. After ascending the hills south of the city, a long descent to the south very soon begins, and continues to Catoma Creek, which is found to the south-east, south, and south-west of the city, at distances varying from three to nine miles. The valley of this stream is from half a mile to a mile in width. Its depressed surface is generally swampy, and its tree, bush, and herbaceous vegetation, luxuriant. The sloping hills which bound it, present strata of flinty clay, and soft marlito, or rotten limestone,—which, together with the superincumbent loam and sand deposits, belong to the cretaceous formation. With such a topography, we cannot be surprised to learn, that this locality is among those which are infested with all the grades and varieties of autumnal fever; but it has never experienced an invasion of yellow fever, although the intercourse by steam-boats, between it and Mobile, is of the most intimate kind.

About ten miles, by land, above the city of Montgomery, we reach the head of Alabama River, or the junction of the Tallapoosa with the Coosa.

The road, for most of the distance, passes over a plateau, which abounds in shallow ponds and stagnant streams, bordered by sloughs, and abounding in various kinds of evergreens. The descent into the valley of the Tallapoosa is by three terraces, the last of which, extending to the river's edge, is subject to deep inundation, as appears from the water-marks on the trees. Four miles from this crossing, is the town of

VII. WETUMPKA.—Its site is at the foot of the long rapids of the Coosa; which river divides it into two villages, denominated, from their position, East and West Wetumpka. The former stands upon a narrow, elevated, and rather rugged plain, with the river on its west, and a range of knobs from one to two hundred feet high, on the east, in close proximity. They are composed of a dry, gravelly, micaceous, red loam, surmounted by pines and chestnuts; and are succeeded, to the east, by still loftier hills. West Wetumpka, connected with the other village by a bridge, is built on the margin of a plain which stretches off indefinitely to the west. A slip of this plain, in front of the lower part of the town, is subject to occasional inundations. On the terrace above, in the south-western part of the village, there is a long, narrow swamp, which discharges its waters into the river below the town. The rest of the site is dry, with a sandy yet not sterile surface. On the north and north north-west, the town plat is dry, and limited by hills similar to those described as lying on the opposite side of the river. About three miles to the west, there is a stream called Mortar Creek, not large enough for mills, which represents many others on the pine plains of Alabama. It consists of a series of narrow swamps, through which there is a sluggish and interrupted current of clear water. The want of declivity lies at the root of this topographical evil. Beds of clay beneath the more sandy surface, prevent the rains from percolating into the earth, and want of fall retards their flowing off; and therefore the water diffuses itself laterally. Trees and shrubs which flourish in such localities, multiply, and when they fall, tend still further to obstruct the feeble current, and thus the marsh or superficial pond is extended. Mortar Creek, which enters the Coosa River three or four miles below Wetumpka, has many tributaries, partaking more or less of its own character, and giving to the country, to the south-west of the town, a great deal of swampy surface. Through some of these sloughs, which are separated by zones of dry wooded plateau, ditches have been dug, with the effect of draining them, and exposing a dryer and highly fertile surface. On a visit to the cotton plantation of Governor Fitzpatrick, which lies in a bend of the Coosa River, between the mouth of Mortar Creek and Wetumpka, he informed me, that much of his land had been redeemed in that manner. That part of it which lies nearest the river, gradually sinks in level, until it becomes subject to inundation. Below the town, the bottoms of the Coosa, on both sides, are, in fact, subject to overflow; and as the river there bends to the west, its alluvial grounds, not less than the swamps or swales of the plain which I have described, unfortunately lie to the south-west or wind-



ward of the town; and this accounts satisfactorily for the decided prevalence of the various forms of autumnal fever, which have visited this place since the beginning of its settlement in 1833. Steamboats from Mobile visit Wetumpka, which is at the head of navigation; but the yellow fever has not occurred.

Another fact must be mentioned to complete the medical topography of this locality. The bed of the river, at the termination of the long falls or rapids, in the upper part of the town, is composed of primitive rocks, *in situ*, having a dip of about forty-five degrees to the north or north north-west. They consist of gneiss and mica slate, which appear to be undergoing constant disintegration. The adjacent hills rest upon these rocks, and, as they abound in mica and silicious materials, may be regarded as the *debris* of the primitive formations, which, further up the river, are developed into a mountainous country, abounding in gold. Wetumpka is, in fact, seated on the last out-crop of the eroceneous formation, at its junction with the primitive. The mica, which is here liberated in large quantities, impregnates the waters of the springs and wells, in the form of an almost impalpable, siliceous powder, which is often observed in the bottoms of the vessels, in which water is kept for drinking. To this impregnation, many of the physicians ascribe the chronic diarrhoea which, in town and country, and also in the state penitentiary, prevails to a degree quite unknown, as it would seem, in any other part of Alabama. When treating of that disease, this hypothesis will be considered.

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## SECTION V.

### BASIN OF THE TUSCALOOSA OR BLACK WARRIOR RIVER.

I. REGION BETWEEN WETUMPKA AND TUSCALOOSA.—The plain on which West Wetumpka is built, stretches off to the west, and for about thirty miles presents a dry, sandy, or clay and gravel surface, overshadowed by forests of long-leaved pine, interspersed with oaks, and having, here and there, a wooded swamp or marshy creek of very limited area. The high, blue hills, which to the north-west embosom the Coosa River, as it flows down to Wetumpka, are frequently in sight; indicating that the route lies near the northern margin of the flat country. The inhabitants on this road are but few, yet the number is sufficient to test its salubrity; and I was assured by several of them that, after leaving the wet lands near Wetumpka, autumnal fever is unknown. At the distance of thirty miles, the road turns more to the north, and encounters the hills, among which water is still scarcer than on the plain, and autumnal fever equally absent. At length the road descends into the low and wet valley of Mulberry Creek, at Maplesville, where autumnal fever abounds. Beyond this alluvial tributary of the Coosa River, a hilly and healthy country is again reached, which continues to Centerville,

on the banks of the Cahawba River, where autumnal fever reappears. A rugged surface, with oak and pine, succeeds; the inhabitants of which enjoy a complete immunity from fever. At length the surface begins to assume a lower and more level aspect, and a dark brown, friable, ferruginous and cretaceous sandstone shows itself, in connection with increasing cultivation; which amelioration continues to the town of Tuscaloosa, on the left bank of the Tuscaloosa or Black Warrior River, about one hundred miles from Wetumpka; and with this change there is some increased prevalence of the fever. This route lies nearly in the mean latitude of thirty-three degrees; and the region which it traverses, affords an instructive illustration of the connection between the surfaces of a country and its autumnal fevers.

II. TOWN OF TUSCALOOSA.—This town, the seat of the University of Alabama, and until lately the capital of the state, stands in N. Lat. about  $33^{\circ} 15'$ , on the eastern or left bank of the Tuscaloosa or Black Warrior River, at an elevation of about one hundred feet above the river. The plain is composed of red and yellow, dry, crumbling sand, gravel, and clay; which, although hard and compact at the surface, is readily undermined and washed away, forming deep ravines. From the north-west round to the south-east, the terrace is abutted by a hill country, through which the river makes its way to the plain. Here, also, is the final out-crop of the imperfectly consolidated cretaceous and tertiary strata; for coal is found but a short distance above the town, as it is also above Centreville, near the Cahawba River; indicating that a carboniferous formation here supports the cretaceous, which at Wetumpka rests upon the primitive. To the west, south-west, and south of the town of Tuscaloosa, the surface differs widely from that in the opposite directions. As it passes by the town, the course of the river is nearly south south-west, and between them there is a narrow slip of low bottom, which widens for a mile above, and then terminates. On the farther side of the river, stands the village of Northford, on a wider alluvial plain, much of which is liable to inundation, when the river is swollen.

A mile or two west of this village, there is a creek called Orange, which flows sluggishly through a foul, wooded swamp, that extends to the river, below the town. On this stream there is a mill, the superintendent of which assured me, that he had been sick with fever every autumn for four years, and that nearly every one of ten operatives, employed in the establishment, had experienced an annual attack of the same kind.

After passing Tuscaloosa and its *faubourg*, Northford, the river turns to the west, which direction it maintains, as Doctor Irish informed me, for several miles, then bends to the south, and finally flows for a number of miles to the east, until meeting Sandy Creek, it again turns to the south. Thus to the south-west of Tuscaloosa, there is a great horse-shoe, or elliptical bend, broader than, but analogous to, that of the Alabama River near Montgomery. Nearly the whole of the extensive tract there inclosed, is liable to inundation when the river rises high, and much of it is overflowed in ordinary

freshets. By the first of June, annually, most of the water drains off, or is evaporated; and then the cultivation of the higher parts is recommenced. These portions are, generally, in the form of long, narrow, flat ridges, between which there are permanent swamps, lagoons, and ponds, with low, foul margins, disfigured by fallen trees, and infested with venomous snakes. One of these ponds, out of which a stream flows during the whole year, has been sounded to a great depth, as Doctor Guild and Doctor Harrington informed me, without finding bottom. It is doubtless a natural Artesian well. Of the swamps, one, overshadowed by liquidambar, and by cypress with long moss, has a length of eight or ten miles, with a breadth sufficient to inclose several islands, on which there are cotton plantations. The operatives on these islands, as I learned from Doctor Drish, are exceedingly subject to autumnal fever. The whole tract, lying, as it does, to the windward of Tuscaloosa, is undoubtedly a chief cause of the fevers which prevail there; which, however, are not as malignant as those of some other localities.

To the south of the town, the plain on which it stands, although, in most parts, dry, is not free from swamps and swales, which combine their sinister influence with that of the horse-shoe bend. Traces of a swamp, which formerly existed in the southern part of the town itself, are still visible.

III. **TUSCALOOSA OR BLACK WARRIOR RIVER.**—This river is properly a large tributary, almost a coequal, of the Tombecbee. Above the town it has the character of a mountain, or at least an upland stream; below, until it loses both its name and waters in the channel of the Tombecbee, near Demopolis, it flows through a wide alluvial valley, most of which is liable to inundation when the river is swollen. At such times, steamboats ascend it to Tuscaloosa. Near Butaw, not far from its mouth, the valley is four miles wide, and so low and flat that much of it is traversed on a causeway of logs, on each side of which there are swamps and ponds, overshadowed by a dense forest, and made foul with the decaying limbs and leaves of trees, mingled with silt from the river. I need scarcely add, that those who live on its banks, from the hill country above Tuscaloosa to its mouth, are subject to autumnal fever.

IV. **COUNTRY BETWEEN TUSCALOOSA AND PICKENSVILLE ON THE TOMBECKEE RIVER.**—The distance between these two points is about fifty miles—the course nearly from east to west. The road keeps within the cretaceous formation, but much of the route is high and rugged. Some of the hills rise, by estimate, five or six hundred feet above the level of Tuscaloosa River; and consist of friable, earthy sandstone, with unconsolidated loam and gravel. The scattered inhabitants of this tract escape autumnal fever. The highest hills are near the Sipsey River, a considerable tributary of the Tombecbee, which has cut itself a deep and wide valley through these loose deposits. Where the road crosses this valley, a causeway of logs continues uninterruptedly for two miles, with foul swamps on either side. In this locality I did not discover either cypress or long moss; though both are soon



in the horse-shoe bend below Tuscaloosa. The latitude is about  $33^{\circ} 20'$  N., being a little north of that of the bend referred to. West of the Sipsey, the country continues dry and rolling, but is less elevated, and, gradually declining, becomes comparatively a fertile plain, for many miles before reaching the Tombekbee River.

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## SECTION VI.

### LOCALITIES IN THE BASIN OF THE TOMBECKBEE.

I. PICKENSVILLE.—This village, which does not contain more than three hundred inhabitants, is seated on the western margin of the plain just described, about half a mile east of the Tombekbee River, and within a mile of the boundary between Alabama and Mississippi. Unimportant as this place may seem, its medical topography deserves attention. The course of the Tombekbee River, at this point, is nearly south south-east. From the north round to the south-east, lies a high and dry plateau, consisting of red and yellow gravelly-loam, cut into ravines, and thinly covered with oak and pine trees. The village stands on the margin of this plain, which, in some places, is thrown up into low hills. On descending from this terrace, through sixty or eighty feet, we come upon the river-bottom, which is subject to annual submersion, and covered with the forest trees that belong to such localities, overshadowing a rank herbaceous vegetation. In the river banks, near the water's edge, we see rotten limestone or marlito (cretaceous limestone), in strata dipping slightly to the south. On the further side of the river, we are again in a low, untilled bottom, subject to frequent overflows, and infested with pools, lagoons, and swamps. This continues to be the case for a mile and a half, when an imperceptible ascent carries us above ordinary floods, but the plain is still swampy; and the streams that meander feebly through it have marshy borders, for the distance of two or three miles; when we ascend a higher and better defined alluvial or diluvial terrace, which the river cannot reach. The surface of this old and upper bottom, is more sandy than that near the river. It bears the forest trees, including pines, which in the south belong to thin and dry soils. The width of this bottom is about two miles. Having traversed it, we make another and greater rise, through a narrow belt of woods and annual plants, common on the limestone lands of Kentucky and Ohio, six or seven degrees further north. This summit-level attained, we find ourselves on the limestone prairies, which will be described hereafter. The topographical section here given is, I believe, applicable to almost every part of the Tombekbee River, above the mouth of the Tuscaloosa, near Demopolis, and not inapplicable to some parts below. In visits to Doctor Yungue, Doctor Swearingen, and Doctor Brown, I had favorable opportunities for inspecting the valley, which extends, longitudinally, nearly from north-west to south-east, and lies directly south-

west of the town of Pickensville, and consequently to its windward. As no other recognized cause of autumnal fever exists in or near Pickensville, we must ascribe its annual visitations by that disease to this valley. One of these visitations, in 1836, almost destroyed or dispersed its inhabitants. Steamboats frequently stop at Pickensville landing, but it has not experienced yellow fever.

11. COLUMBUS, MISSISSIPPI.—The distance from Pickensville to Columbus is about twenty-three miles. East of the Tombecbee River, the road runs over a surface dry and somewhat broken, composed of the same materials with the plain at Pickensville; and bearing oaks and pines, as its predominant forest trees. To the east, the country rises still higher, and presents the final out-crop, in that direction, of the cretaceous formations: to the west is the broad trough of the Tombecbee, and beyond it the prairies. The town, standing on the left or east side of the river, has for its site a long and rather narrow plain or ridge, on the east side of which is a valley, while on the west we have the Tombecbee River. The valley opens into that of a stream called the Looksphehlila, which discharges its waters into the Tombecbee, two miles below the town, and has its own wide bottoms overflowed whenever the river is swollen. The sources of this tributary are found in broken pine and oak lands, composed of loose materials, east and north-east of the town. In summer, the waters of these heads or sources stagnate; and in their valleys there are, moreover, small lagoons and cypress swamps, which generate autumnal fever among the inhabitants, who are sufficiently remote from all other insalubrious localities. The trough of the Tombecbee, opposite Columbus, does not differ materially from that near Pickensville, already described. The site of the town, on the river side, has a bluff bank seventy or eighty feet high, to the base of which the river makes a near approach; though immediately above, there is a wide and wet bottom between them. In traversing the bottom, west of the river, and opposite the town, we find it low and subject to inundations, which leave sloughs and lagoons behind, overshadowed with cypress, destitute of its more southern parasite, the long moss, which here does not reach the latitude of thirty-three degrees thirty minutes. Then comes a higher and cultivable terrace, not subject to inundation, but traversed by lagging streams, and bearing oaks and pines; to which succeed, as at Pickensville, the prairies. In ascending upon the prairies, we see in the banks of the rivulets, the friable or rotten cretaceous limestone, resembling that which the banks of the river at Pickensville present. The intermediate terrace, between the low alluvial bottom and the prairies or highest uplands, is inhabited; and here, as well as opposite Pickensville, it is declared to be more unhealthy than the low and wetter bottoms. The plantations on the latter are, however, too few to admit of a satisfactory comparison; while the two belts are so contiguous, and so dove-tailed into each other, that whatever cause of disease is generated on the lower, of necessity affects the people living on the upper and

dryer plain. As the general course of the river here is the same as at Pickensville, its broad, alluvial, pondy, and marshy valley, unfortunately lies to the south-west or windward of the town. The following fact, which I received from Doctor Jones, seems worthy of being recorded as a part of its history.

In the summer of 1837, a field of oats, when nearly fit for the sickle, was inundated by a great rise of the river. After the flood had receded, Doctor Jones sent six negro men to cut the tangled, half-dead, and decaying crop. They lodged on the premises, in a shanty, for nearly a week, when one of them sickened with fever, and the whole were recalled. All, however, were soon afterwards taken down with intermittents or remittents, while the different families from which they had been detached, remained healthy.

In the early periods of its settlement, from 1822 to 1825, Columbus was much infested with autumnal fever, but latterly it has suffered less. Its latitude, as I have intimated, is about 33° 30' N.

III. THE PRAIRIES.—The tract of country which is denominated 'The Prairies,' is found chiefly on the western side of the Tombecbee River; but that stream, changing its course, at length, from south south-east to south, traverses the prairie-country; so that land of the same description is found to a considerable distance east of that river, in Greene and Marongo counties, where it gradually becomes wooded, and has received the name of 'The Cane-brakes,' from a luxuriant growth of native cane (*Miegia*). I cannot state the precise limits of this tract in the north and west. I was informed by Mr. Billups, one of its most intelligent inhabitants, that it begins above the county of Lowndes, of which Columbus is the seat of justice, and extending southerly, through Noxubee county, enters the state of Alabama from the west. According to another authority, it is found in the latter state, in the following counties: Russell and a part of Barbour; Macon and Tallapoosa, with a part of Pike; Montgomery, Lowndes, Dallas, Wilcox, Autauga, Perry, Marengo, Sumpter, Greene, with portions of Tuscaloosa, Pickens, Bibb, and Shelby. This extensive enumeration, however, refers rather to a tract which has the same geological constitution as the prairies, than to a surface destitute of trees and free from overlying deposits of 'sterile sand, gravel, or ferruginous clay,' which constitute the greater part of the surface embraced within those broad limits. The best specimens of prairie-surface, in Alabama, are included in Greene and Marongo counties.\* Even the true prairie district is by no means destitute of trees, but abounds in tracts of forest, some of which seem once to have been the beds of ponds or lakes, and are called 'hummocks.' The vegetation of these basins is identical with that of the most fertile limestone borders of the Ohio River, while that of the country generally is entirely different. The prevailing width of this tract, in

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\* Mr. C. S. Hale of Mobile, in Doctor Lewis' admirable paper on the Medical History of Alabama: New Orleans Med. and Sur. Jour., Vol. III, No. VI.



the state of Mississippi, as Mr. Billups informed me, is about twenty miles. It was inhabited by the Choctaw Indians, before their removal to their present residence beyond the Mississippi. Geologically, the prairies are the out-crop of a thick formation of soft, cretaceous or rotten limestone, which dips to the south south-west, and has a line of bearing nearly east and west. According to Mr. Hale, \* "The lower strata of the series consist principally of silicious sand, with various inter-stratifications of green sand, clay, and limestone; above these is a bed of soft, impervious, argillaceous limestone. This bed, commonly known as rotten limestone, is in some localities from two to three hundred feet thick, while in the others it is found exceedingly thin, but never disappearing. Resting upon this stratum is a deposit of yellow pulverable limestone, which in a few instances is replaced by a pure white carbonate of lime." The soil, consisting largely of the *debris* of this formation, intermixed with the remains of animals and plants, is extremely fertile. Doctors Cooper and Gibbs, of the College of South Carolina, analyzed two specimens of this soil,—one from a high and dry, the other from a low and humid spot of the same plantation. The former contained twenty-five per cent. of carbonate of lime, and twenty-eight per cent. of organic matter; the latter, fifteen per cent. of carbonate of lime, and twenty-five of organic matter; the other ingredients were alumina and a small quantity of silox and iron. No attempt was made to separate the animal from the vegetable elements of the organic matter. Doctor Lewis supposes the former to predominate, which may be doubted.† As the general aspect of the prairies is level, the rains flow off but slowly, and hence marshes or sloughs are numerous, and every stream has not only a sluggish current but swampy borders. In the summer these surface-waters evaporate; and, as the strata beneath are almost impervious, there is a want of spring and well, not less than of running water.

IV. THE CANE-BRAKE.—To the south-east, in Alabama, the prairies, as I have already said, are transformed into wood-lands, and covered (where not cultivated) with a dense brake of tall cane. This is the case with portions of Greene, Marongo, Perry, Dallas, and Wilcox counties, quite through to the Alabama River. The black soil of this tract is several feet deep, adhesive, and almost glutinous. Its fertility is exhaustless; but it is as badly watered as the prairies, being, geologically, the very same region.

V. ARTESIAN WELLS.—On the settlement of the prairies and cane-brake, it was soon discovered that they were badly watered. This led to well-digging; which, however, failed to supply the *desideratum*. A feeble percolation or oozing was all that occurred, and no depth of digging procured more than a moderate supply of warm, very hard, and sulphurous water. These excavations, called by the people 'sipo (seep) wells,' are now held in small estimation; and the reliance, on all the extensive plantations, is on

\* *Loco citate.*

† *Ibid.*

Artesian borings, of which I saw specimens, from Lowndes County, Mississippi, to Greene and Marengo counties, Alabama. Those which I visited, varied in depth from one hundred and twelve to five hundred and twenty feet; which was the depth of that on the plantation of Mr. Billups, in Noxubee county, Mississippi, twenty miles south of Columbus. The water rose within sixty feet of the surface, and he had sunk a well, below that depth, by the side of the boring, to serve as a reservoir, out of which he would pump the water; a common resource, when it does not rise to the surface of the ground. As the strata crop out successively, and constitute the surface of the country, I may give the following statement, derived from him, of their nature, as ascertained by the boring.

Black soil, succeeded by reddish loam, - - - - 8 feet.

Hard, whitish clay, - - - - 4 "

Bluish rotten limestone, with very hard sulphur balls (pyrites), 408 "

Gray sandstone, so hard as to require the pick, - - - 10 "

Then a feeble vein of water, followed by sand—soft sand rock

—and finally, by hard, gray sandstone, - - - 90 "

Then a second and more copious supply of water.

In the southern part of Greene county, Alabama, near the residence of Doctor Dancy, I visited seven wells of the same kind, the shallowest of which was one hundred and twelve feet; the deepest, three hundred and twenty feet. Water flowed from the whole of them, either in a feeble or strong and copious stream. The depth and temperature of each is presented in the following table, beginning with the shallowest:

No.	Depth.	Temperature.
1	112 Ft.	66° Fahr
2	255	68°
3	268	69°
4	290	67°·5
5	307	69°
6	311	67°·5
7	320	67°
Average,	266	67°·71

As some of these borings were in superficial valleys, and others on low ridges, the figures in the second column do not accurately express their depth below the general level of the country. It may be considered remarkable that there should be so little relation between their depth and temperature. The shallowest, it is true, falls one degree and seventy-one hundredths below the average, but the deepest falls nearly three-quarters of a degree below, and one, which in depth is at the average, in temperature is at the maximum. There was no copious and permanent surface-spring in the neighborhood with which to compare them; but a few minutes of latitude to the south, on the Tombecbee River, not far from Moscow landing, where the limestone has sunk below the river, I found the temperature of a copious spring, which burst out forty feet from the top of a clay and gravel bank, to be sixty-two

degrees. As this observation was made on the second day of June, it could not indicate a winter temperature, and, therefore, we may conclude that the difference of five degrees and seventy-one hundredths of temperature, was the result of the difference of two hundred and twenty-six feet of depth, being one degree of increased heat for about every forty feet of descent below the level of the spring, taken as a standard. The water of all the Artesian wells which I visited, had a perceptible sulphurous taste, and, tested with acetate of lead, afforded a white, granular precipitate, indicating, of course, the presence of some muriatic or sulphuric salt; — still it is so soft as to be used by the people for all domestic purposes, without any preparation.

As many of these wells afford a large quantity of water, which flows by night and day, their multiplication, if means should not be adopted to restrain and regulate the discharge, must, at length, create ponds and marshes, which can scarcely fail to prove insalubrious.

In liability to autumnal fever, the prairies hold an intermediate place between the river-bottoms and the sand and loam plains, which bear oaks and pines. I was told by Mr. Bibb, who resides upon the prairies, twelve miles south of Columbus, that, for several years, while he kept his operatives on the slopes of the prairies near the diluvial plain or old bottom of the Tombecbeo, they suffered much from autumnal fever; which led him to remove them a few miles back, where they enjoyed excellent health. He knew of many other cases of the same kind. Mr. Moore, a few miles off, had found the prairies decidedly healthy. In nine years, out of one hundred operatives, but two adults and three or four children had died. Mr. Billups, his neighbor, however, in eight years had lost twenty out of one hundred and twenty; of whom but two were adults; yet eight only of the whole had died of fever. Nevertheless, the prairies, as I learned from various persons both in and out of the profession, may be said to be *subject* to that form of fever; but they are healthier than the cane-brake, in which there is a deeper mold.

VI. GREENSBORO.—This town, one of the oldest and most noted in Alabama, is situate in about N. Lat. 32° 40', near the northern border of the prairies, in the west of Greene county, between the sources of Big or Brush Creek and a branch of Big Prairie Creek, both emptying into the Tuscaloosa, near its mouth. The site of Greensboro is undulating and dry. The upper stratum consists of sand, loam, and gravel, being a part of the widespread deposit on which Pickensville and Tuscaloosa have been built. To the south and south-west of the town, there are small ravines or valleys, which inclose sluggish wet-weather streams, with marshy borders, having a soil of the richest quality, and producing, along with a luxuriant herbaceous vegetation, a considerable growth of small cane;—hence they are called 'switch-cane marshes' and 'reed-brakes.' These localities, which might, by ditching, be made dry, are at present very unhealthy. In reaching them, we pass for one or two miles over rolling and sandy pine and oak lands. From west round to north, the country is poor and ridgy. Its springs form little



streams, with marshy borders from fifty to one hundred yards wide. To the north, at the distance of five miles, is Big or Brush Creek, the valley of which, a mile in width, is a swamp throughout. A farm, on its north or leeward side, has been found one of the most unhealthy in the whole country. To the north-east, the branches of this creek meander in swampy valleys, one of which embraces a mill-pond, and all are insalubrious. To the south-east, there is an extensive slough or swamp, in the neighborhood of which fevers greatly abound. Thus, while the immediate town plat is free from the conditions which generate autumnal fever, they abound in the surrounding country; and the inhabitants of both have, from the beginning of immigration into this region, experienced very violent intermittent and remittent fevers, which, however, are more prevalent in some localities than others.

VII. DEMOPOLIS.—This town, one of the newest in the valley of the Tom-beckee, is situated on the left or eastern bank, immediately below the mouth of Tuscaloosa River. On both sides of the latter there are wide bottoms, subject to annual inundations. The site of Demopolis is dry, and elevated above the highest floods of the river. It bears a spontaneous growth of red cedar, and, except the drowned bottoms just mentioned, is more favorably situated as to health than many other towns in the region to which it belongs. The river-face of the bank on which the town is built, shows a formation of cretaceous, semi-indurated limestone, which bears a different aspect from that seen further up the river, as at Pickensville; but it has, like that, a manifest southern dip. The upper layers, which are dry, display an almost chalky whiteness, while the lower and damper are of a light slate-color. The whole presents lines or fissures, more or less perpendicular, some of which contain crystals of carbonate of lime. Nodules of martial pyrites are also common. Near the water this rock softens like marl, and is perforated by some kind of lithodome. Demopolis and its neighborhood are exceedingly deficient in water. The 'sipe-wells' afford but little, and that is almost saturated with lime, and imparts a sulphurous taste. Artesian borings have been resorted to, but the locality is, geologically, too high. One boring, on the town plat, six hundred feet deep, brought up to within ten feet of the surface, a moderate supply of very bad water. Other borings, eight hundred feet in depth, have failed. The resource of the people is in cisterns or wells so lined or plastered as to prevent transudation from the surrounding strata. These are filled by the cold rains of winter, and those of summer are excluded. In this way a very tolerable drinking-water is obtained. The people of Demopolis regard themselves as unfortunate, in not having obtained water by Artesian borings; but they have not gone deep enough to reach the water-bearing stratum. Its depth might be calculated from the angle of inclination of the strata at Pickensville, taken in connection with the depth of the borings west of that town. Everywhere in this region, the Artesian water is considered salubrious; as an evidence of which, Doctor Strudwick, of Demopolis, mentioned to me, that on a plantation of his, the operatives,

who had been sickly under the use of the water of a 'sipo-well,' became healthy as soon as he had made an Artesian fountain.

Demopolis, although not so disadvantageously situated as some other towns of Alabama, in reference to those topographical conditions which generate autumnal fever, is by no means exempt from that disease. It has constant steamboat communication with Mobile, but has not experienced yellow fever.

VIII. THE LOWER TOMBECKEE.—From Demopolis, the Tombecbee River flows nearly south, to mingle with the Alabama. Not far below the town, as I have already intimated, the cretaceous marl on which it stands, from dipping southerly, disappears beneath the river, whose banks, like those of the Alabama, above Claiborne, are composed of deposits of various-colored loam, gravel, sand, and clay, with wide overflowed bottoms. The cocoon or old tertiary limestone is at length traversed, and below, the valley of the river widens, and at the same time becomes deeper. The tides of the Gulf are perceived, I was told, farther up than Jackson, nearly one hundred miles above Mobile, and one hundred and thirty from the open Gulf. The low bottoms embrace extensive cypress swamps with long moss; the distant bluffs have a reddish color. The water of the river has an indescribable, dirty-brown color, with now and then a shade of greenish yellow. Its transparency is greatly reduced. In this condition it unites with the Alabama, sixty-five miles above the city of Mobile. This point, or, rather, the high-lands in its rear (for the point is subject to inundation), was once the head of Mobile Bay; and here commences the estuary, of which some account has been already given.\*

IX. THE HILL-COUNTRY.—Repeated allusion has been made to the low alpine region, which lies beyond the cretaceous formation, and constitutes, through the northern part of Alabama, a water-shed, from which tributaries of the Tennessee descend to the north, and the various head waters of the Tombecbee, Tuscaloosa, Cahawba, and Coosa, flow off to the south. The eastern portion of this range, where the Appalachicola, Tallapoosa, and Coosa have their origins, is, on its southern side at least, composed chiefly of primitive rocks, typically impregnated with gold. Further west, transition or Silurian limestone occurs, overlaid or flanked by a coal formation. Thus the geology of the hill-country differs from that of South Alabama, as much as its topography. In regard to the latter, however, it may be remarked that but little of it is really mountainous; the larger part is only hill-country. The streams have a rapid current, which, with the density of the old rocks over which they flow, has prevented their excavating wide alluvial and swampy valleys; while the rugged surface has rendered the formation of ponds and marshes at a distance from the water-courses equally impossible.

Nevertheless, this region, which may be called Middle Alabama, is not ex-

\* New Orleans Journal, *loc. citato*.

empt from autumnal fever; which, however, is most prevalent in the vicinity of creeks, even when formed chiefly by copious springs. Doctor, now Professor, Grant, of Memphis, who formerly lived four years in Benton county, between the Coosa and Tallapoosa, near the thirty-fourth degree of latitude, saw, as he informed me, much of this fever, both intermittent and remittent. One summer, after copious spring rains, it invaded the inhabitants of the pine hills. In Jacksonville there is a limestone spring, which discharges a great quantity of water; and it is notorious, that those who live nearest to it, and to the brook which it supplies, are most unhealthy. Doctor Clarke has given nearly the same account of the fevers of the same county. This locality, I suppose, may be taken as the representative of all the hill-country from Georgia through to Mississippi. Of the whole region, Doctor Lewis\* remarks, that the "fevers of an intermittent and remittent type, usually make their appearance about the first of July; increasing in number and becoming more violent in the month of August, with occasionally one of a typhoid character; and by the first of September, they have attained their maximum point, and usually begin to decline in October."

## SECTION VII.

### OUTLINES OF THE REGION BETWEEN THE TOMBECKBEE AND MISSISSIPPI RIVERS.

The Tombecbee River, of which so much has just been said, originates in the depressed extremity of the western spur of the Appalachian Mountains, which constitutes the water-shed between the Ohio Basin and the Gulf of Mexico. Its sources are chiefly in the north-east corner of the state of Mississippi; subordinately, in the north-west corner of Alabama. Passing from the former to the latter state, at Pickensville, it pursues a course directly south to Mobile Bay, at a short distance from the dividing line between the two states. Its direction is nearly parallel to that of the Mississippi River, from which it is distant, in a straight line, from one hundred and fifty to two hundred miles. Its extreme length, in a straight line, is three hundred miles. Thus, the region on which we have now entered is a parallelogram, with its longest sides nearly in the meridian. It includes the state of Mississippi, and, in its south-west corner, a small part of Louisiana.

Few portions of the Mexican Basin, of the same extent, present as much geological and topographical uniformity, as this region. According to the geological map of Mr. Lyell, compiled from the best authorities,† the whole region embraces but two formations: 1. The post-tertiary and tertiary; 2. the cretaceous. The former extends north from the Gulf of Mexico (between

\* Med. Hist. of Alabama: N. O. Journal, before cited.

† Travels in North America. By Charles Lyell, Esq. 1845.



Mobile Bay and the Mississippi River), to a line running across the middle of the state of Mississippi, nearly east and west, from the Tombecbee River, below Demopolis, to the trough of the Mississippi, above Vicksburg. All above, or to the north of this line, belongs to the cretaceous formation; for the older carboniferous and Silurian groups, which constitute so much of the hill-country of Alabama, do not occur in Mississippi, at least to such an extent as to merit the notice of the medical geologist. The whole surface of the region here sketched out, is composed of loose, miscellaneous ingredients, readily disintegrated, and easily transported by water. Its elevation above the level of the Gulf is small. The highest parts are to the north-east, at the extreme sources of the Tombecbee; but they do not, probably, exceed six or seven hundred feet, while the greater part ranges from four hundred down to fifty feet. In the south of this region, we have Pascagoula and Pearl Rivers; in the north and north-west, the Big Black and Yazoo; in the north-east, the upper part of the Tombecbee; nearly all too shallow, narrow, or obstructed, for successful steamboat navigation. An effect of this hydrographical condition is, that the towns of the state of Mississippi are not, like those of Alabama, on the banks of rivers, except those which are found on the Mississippi River. Having already treated of them, and of the localities which lie on the Gulf of Mexico — having, as it were, traveled round the region under inspection, it only remains, in a series of sections, to describe its interior. This, however, I shall not be able to do with much fullness; for I did not penetrate it in many places, and its physicians have not published much upon its medical topography. We shall begin in its south-east corner, with the first river west of Mobile Bay.

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## SECTION VIII.

### BASIN OF PASCAGOULA RIVER.

This out-of-the-way and little-known district, constitutes the south-east angle of the state of Mississippi. Its narrow base, embracing Pascagoula Bay, may be seen on the map of the Delta of the Mississippi (*Pl. V*), and has been already described under the head of Gulf Coast. The basin of Pascagoula River is intermediate between the Tombecbee River and Mobile estuary, to the east, and Pearl River, to the west. It embraces, entirely or in part, fifteen counties of Mississippi; and while its mouth is below the latitude of  $30^{\circ} 30'$ , its extreme sources are in  $32^{\circ} 40' N$ . Thus it flows through more than two degrees of latitude. The whole of this basin lies in the tertiary formation, and presents on its level or undulating surface deposits of sand and loam, which, in the northern portions, attain an elevation of four or five hundred feet above the Gulf. Through these loose strata the streams have scooped out their valleys, many of which have considerable breadth. The bottom-lands are fertile, and heavily timbered with the forest

trees appropriate to such localities in the south; but are mostly subject to inundations in winter and spring, which greatly limit their settlement and cultivation. Along the Pascagoula River there are, however, old or diluvial terraces, such as have been described on the Tombecbee, presenting hummocks, which are above the reach of the highest floods. The uplands or plains vary in fertility, from the dry, sandy surface on which the long-leaved pine luxuriates to the exclusion of almost every other tree, through that in which it shares dominion with the oak, to one sufficiently fertile to bear a miscellaneous forest vegetation, when we meet with tracts of the richest hummock. As a general fact, the poorest uplands, and the broadest, lowest, and wettest bottom-lands, are nearest the Gulf. Almost every part of the whole basin abounds in permanent springs, the result of infiltration from the surface.

Mr. Darby\* informs us that the "general aspect of the soil on the waters of the Pascagoula is sterile; but on their margins a considerable surface of good farming land exists. Pine forests reach the Gulf of Mexico on both sides of Pascagoula Bay." Doctor Merrill, of Natchez, in 1810 and 1820, was the surgeon of a regiment of troops which cut a military road through this basin, from west to east. He found it a level pine plateau, with but few swamps or ponds. The troops, recently from the north, were subject, in summer and autumn, to a mild and simple remittent fever, of which very few died.† Speaking of that part which lies near the Gulf, Mr. Darby says, its unfruitfulness is counterbalanced, to the inhabitants, by the health they enjoy. According to Besançon,‡ most parts of it are but little affected with the fevers of autumn; and of one county he says, it is "too healthy to support a physician, too honest to need a lawyer, and too free from debt to furnish any salary to the clerk of a circuit court." On the whole, we may conclude, that the Pascagoula basin affords, in its autumnal salubrity, instructive evidence of the connection, in the manner of cause and effect, between the topographical condition of a southern region and its bilious fevers. If the obstructions to the navigation of the Pascagoula River, which lie at its mouth, and consist of bars formed by the silt of the river and the sands of the Gulf, were removed, so that its deep waters could be entered by steamboats, its banks would afford many healthy, retired, and pleasant retreats, for the people of New Orleans and Mobile, during the sickly season.

\* Geog. Descrip. of La., p. 296.

† MSS. *pence mc.*

‡ An. Reg. of the State of Mi., 1838.

## SECTION IX.

## BASIN OF PEARL RIVER.

I. This basin, which occupies more than half the longitudinal center of the state of Mississippi, extends from the *Rigollets*, between Lake Pontchartrain and Lake Borgne (*Pl. V*), on the Gulf of Mexico, in N. Lat.  $30^{\circ} 10'$ , to N. Lat.  $33^{\circ} 10'$ . But, while its length reaches through three degrees of latitude, its breadth does not average more than three quarters of a degree of longitude. It is, in fact, the narrowest basin, in proportion to its length, that can anywhere be found in the Interior Valley. The river, originating in or near the cretaceous prairies, south-west of Columbus, on the Tombigbee, soon passes the line of junction between that formation and the tertiary, and flows through the latter, by a course nearly south, to the Gulf. Its immediate valley, or trough, is wide, with rich, wooded bottom-lands, almost everywhere subject to inundations, which leave ponds, lagoons, and cypress and liquidambar swamps. The uplands, on each side, are sufficiently level, and through the lower half of the river's length, especially on its eastern side, are covered with pine. On the western side generally, and on both sides as we ascend the river, the land becomes more fertile and rolling, with hummocks, cane-brakes, and even whole counties of productive soil. The tributaries of Pearl River are, in general, very short; but many of them, especially the lower, are fed by copious springs. Most of them flow through wide alluvial valleys, which are less liable to overflows than those of the main stream, yet are not free from swamps and swales, which render their banks unhealthy in autumn. The upper part of the basin, although more productive, is not so well supplied with springs, and, from its richer mold, is more liable to autumnal fever than the lower. Hitherto, Pearl River has been found difficult and precarious in its navigation; in consequence of which it has no large commercial towns to interest the medical topographer. The capital of the state of Mississippi stands, however, on the west or right bank of this river, about N. Lat.  $32^{\circ} 20'$ , and, having made a visit to it, I shall give a sketch of its topography.

II. JACKSON.—The immediate site of the town is elevated; some parts of it gradually rising into a considerable swell or tuberosity; though other parts were, originally, a kind of morass, now filled up. Between the town and the river, to the east north-east, there are ponds of clear and cold water, supplied by springs. Extensive low bottoms lie to the north-east, east, and south-west, which are covered by dense forests, and suffer annual inundations. To the west, a small tributary is skirted with narrow, wet, alluvial grounds. Formerly the inhabitants drank a very impure well-water; latterly, they rely chiefly on cisterns, replenished in rainy weather. From Dr. Gist, who has devoted himself to the study of the geology of this region, I learned that, in descending from the surface, there is, *first*, a bed of mold; *second*, a bed of yellow clay or loam, seven or eight feet thick; *third*, a bed of gravel, variable



in thickness, but, generally, about three feet; *fourth*, a stratum of blue clay, from eighty to one hundred feet through; *fifth*, sand, of unknown depth. The second and third (loam and gravel) are often wanting. The fourth (blue clay) sometimes assumes a white, gray, or yellow hue. It abounds in beds of indurated carbonate of lime, or rotten limestone, marl, and gypsum; and sulphates of iron, soda, magnesia, and alumina, have also been detected in it. It abounds in marine shells, remains of trees, and bones of land animals. The fifth, or sand stratum, in its upper part, resembles the mud of the river; having decayed animal and vegetable matters mingled with it, and sending up carbonic acid gas. At the depth of a few feet, the sand assumes a white color, and retains it, as far as borings have been made. This bed, which, by its undulations, comes much nearer the surface in some places than in others, abounds in animalcules, of the same kind that are found in the neighboring ponds, which are fed by springs. All the wells which terminate in the blue clay, afford bad water, and likewise some of those which pass through it; but a pure water is supplied by the springs which burst out from the white sand, where it approaches the surface near enough to be cut into by the streams. This interesting description is no doubt applicable not only to Hinds county, one of the largest and richest of the state, in which Jackson is situate, but applies also, with some modifications, to all the northern belt of the tertiary deposits through Mississippi and Alabama.

For several years after the beginning of settlements, this locality was subject to autumnal fevers of a most malignant character; but latterly, they have been much milder. Of the basin of Pearl River, generally, it may be said, that places near the river, and on such of its tributaries as have wide bottoms, are insalubrious; but the pine and oak lands, and other tracts of richer surface, but rolling and remote from water-courses, are comparatively healthy.

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## SECTION X.

### REGION BETWEEN PEARL RIVER AND THE MISSISSIPPI: THE BLUFF-ZONE.

I. In concluding our survey of the region immediately north of the Gulf, we come to the most populous and productive portion of the whole, called by Mr. Darby the bluff-zone. Resting on the Bayou Hoville, on the lower part of Amite River, on Lake Maurepas, and on Lake Pontchartrain, in N. lat. about  $30^{\circ} 10'$ , the bluff-zone extends directly north, keeping parallel to the Mississippi River. Its southern end, up to the thirty-first parallel, comprehends the parishes of St. Tammany, Livingston, Baton Rouge, West and East Feliciana, St. Helena, and Washington, all in the state of Louisiana. Washington and St. Tammany, from reaching to Pearl River, are partly included in its basin. Baton Rouge, East Feliciana, and a small part of West Feliciana, rest on the Mississippi. The most important river of this

tract is the *Amité*, which, traversing it centrally, pours its waters into the Bayou Iberville, and gives its name to the united streams.

II. According to Mr. Darby,\* a transverse belt of this zone, about twenty miles wide, extending from the Mississippi to Pearl River, rises very gradually from the water-base line which has been described. It is an almost unbroken acclivity, covered, over its whole area, with forest trees, of which the most numerous are the liquidambar, and the quercitron oak. Along the streams, there are cypress, long moss, live-oak, and cane. Near the Mississippi there are vast liredendrons or tulip-poplars, and over the whole, laurel magnolias. This inclined plain is diluvial, and corresponds with the old or second bottoms of the Tombecbee, which have been mentioned. Its surface is moderately fertile. Immediately succeeding to this belt, there is another of nearly the same area; 'the surface of which,' according to Darby, 'is broken, often considerably elevated, the soil diversified in quality; near the streams, often fertile, but a much greater proportion covered with pine (*Pinus rigida*), and sterile. Springs of excellent water become frequent, and the creeks and rivers are fine bold streams of very pure limpid water.'

As to fertility, it may be stated that the eastern portions (bordering on Pearl River) of both these terraces, are more sterile and piny than the western. In this quarter we have

III. MADISONVILLE.—The site of this village is on the right bank of the small river Chifunoti, near its junction with Lake Pontchartrain. Its direction from New Orleans is indicated on the map of that city (Pl. VI). It is surrounded by pine woods, and constitutes one of the retreats of the unacclimated population of the city, during the prevalence of yellow fever. Its vicinity, and the eastern portions generally of the region we are now considering, are more exempt from autumnal fever than those to the west, which are more fertile, and lie in the rear of Baton Rouge and Bayou Sara, which were described in Chapter V.

IV. We may take another section of this bluff-zone, extending from the thirty-first to the thirty-second degree of north latitude, and lying in the state of Mississippi, immediately north of the preceding. Its position will be best indicated, by saying that the city of Natchez stands near the middle of its western margin. The counties which compose this transverse section of the bluff-zone, are Wilkinson and *Amité*, adjoining Louisiana, then Adams and Franklin, then Jefferson and Claiborne, with the single county of Copiah in their rear to the east. This region embraces the oldest-settled, and, in many respects, the most interesting portion of the state of Mississippi. The *Homo Chitto* and Bayou Pierre are its most considerable streams, both of which flow into the Mississippi. Its surface is considerably elevated and rolling—some of it even low-hilly. Although generally fertile, it embraces tracts of pine with thin soil. Nearly one-half of *Amité* county, in

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\* Geog. Descrip. of La., p. 92.

which the river *Amité* originates, is covered with long-leaved pine; while another portion, known as the 'Pine Ridge,' passes diagonally through the county of Adams, to strike the Mississippi a short distance above Natchez. Nevertheless, taken as a whole, this tract is decidedly fertile, and is, or was, clothed with a miscellaneous forest, which overshadowed extensive cuto-brakes. In many places, small ponds or sloughs disfigure the surface; and along the streams generally, there are foul alluvial bottoms, subject to inundation. In consequence of this, the most extensive and valuable plantations are on the uplands. Permanent springs are scarce, and the well-water is offensive, and regarded as unhealthy. Though pellucid, it deposits, on standing, a whitish sediment. Most of the wells terminate in rotten (tertiary) limestone. I brought away a bottle of water, from a well of very bad repute, in Jefferson county, several miles back of the river-town of Rodney, already described, which, after the lapse of three years, was examined by Doctor Raymond, who found a spontaneous deposit of crystallized carbonate of lime. All the carbonic acid gas, which kept the lime in solution, and the sulphuretted hydrogen gas, which gave the water an unpleasant smell, had escaped. Except the lime, Doctor Raymond could not detect any foreign matter.

To supply their wants, the planters, in many parts of this district, resort to cisterns. Those to contain drinking water, are filled by the rains in winter; those for stock or other purposes, at any time. Many of these cisterns are from twelve to fifteen feet in diameter, and twenty to thirty feet deep. Some large plantations have several, in different parts, as convenience requires. The stock, not less than the people, prefer this to well-water. As a general fact, all the fertile portions of this region are subject to autumnal fevers. Some account of a few localities will illustrate what has been said.

V. WOODVILLE.—This town is situated fifteen miles from the Mississippi River, in the interior of Wilkinson county. Its elevation above the level of the Gulf is three hundred and forty feet; above the river, at low water, about two hundred and sixty. Its latitude is  $31^{\circ} 7' N$ . The geological formation on which it stands, is tertiary sand and clay. According to Doctor Stone and Doctor Kilpatrick, its site is the dry rolling land which separates the head waters of the Bayou Sara, Thompson's Creek, and Buffalo Creek from each other. Some of the small tributaries of the last, originate on the town-plot, and as they flow off to the north, pass through broken pine lands, and are skirted with narrow swamps; but the town and its environs, in other directions, are entirely exempt from stagnant water, which, from the unevenness of the surface, cannot accumulate into ponds or marshes. In every direction around the town, except to the north, there are extensive cotton plantations, which have been cultivated more than forty years. The population of the town is eight hundred. It has always been regarded as one of the most pleasant, and, in reference to autumnal fever, one of the healthiest towns in the south-



west; yet, in 1844, it experienced a severe visitation of yellow fever.\* Washington, another town of this zone, has been already described in connection with Natchez, from which, its participation in the epidemics of that city, do not permit it to be separated by the medical topographer.

VI. OAKLAND COLLEGE.—The site of this rural institution is in Claiborne county, six miles from the Mississippi River. The road from Rodney reaches it over ridges and tuberosities, composed largely of tertiary sand and loam; but the college grounds, and their vicinity, overshadowed by oak trees, are more level. Visiting it in the month of June, I did not see a single spring or stream of any kind; and so great is its destitution of water, that, very often, in summer and autumn, the Mississippi River is the only resource of the inhabitants. The prevalence of autumnal fever, in this locality, is small; but at the distance of three or four miles, where the soil, although dry and rolling, is richer, and produces cane, that disease is common and often violent.

VII. PORT GIBSON.—Near the central part of the same county, Jefferson, stands the town of Port Gibson; so called because there flows near it a stream, of sufficient depth, in wet weather, to float cotton boats to the Mississippi; from which it is distant ten or eleven miles. The drive to it, from the town of Grand Gulf, was most of the way over hills and ridges, the sides of some of which were rather steep. Before reaching it, the road descended into the broad, low, alluvial valley of the Bayou Pierre; which is composed of two principal branches, that unite near Port Gibson, the site of which is on the left bank of the southern fork. When the Mississippi rises high, the bottoms of the Bayou Pierre are overflowed; and, should that creek at the same time be swollen by rains, the inundation is rendered wider and deeper. The plain on which the town stands is dry, and sufficiently elevated above the stream. I found it clean, and well shaded with trees. It also has a number of wells, from twenty to forty feet deep; and much less cistern-water is drunk here, than in many other parts of the district which we are now surveying. Thus, in the tertiary formation, the water obtained from different strata is by no means uniform in character. To the east of the town, between it and the creek, there are some low, wet grounds; and on the cape or peninsula, above the junction of the two branches of the Bayou Pierre, to the north-east and north, are ponds left by the inundations. In the opposite directions, the country is moderately level, fertile, and free from swamps. Port Gibson is subject to mild attacks of autumnal fever. In the surrounding country it is more frequent and fatal. It has not experienced an invasion of yellow fever.

VIII. A COMPARISON OF LOCALITIES.—When we compare the two sections of the bluff-zone which have been described, with the basins of Pearl River and the Pascagoula, we find identities and diversities which are worthy of being noted: *first*, they are all included within the same parallels of latitude—all incline to the south—and all belong to the same tertiary deposits; yet,

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\* New Orleans Medical Journal, Vol. I, p. 530; Vol. II, p. 40.

*secondly*, the depth and continuity of fertile soil, and the variety and luxuriance of tree and herbaceous vegetation, are much greater in the former than in the two latter. Now to what causes shall we ascribe this difference? I am not prepared to say that some variation in their mineral constitution may not exist, as an efficient agency in the case, but am inclined to ascribe much of the difference to the contiguity of the Mississippi River, and its wide, swampy, and pondy bottoms. In the great prairies of the west, trees and a rich vegetation are only found near the rivers. On the western side of Lake Michigan, I found a belt of lofty forest, two or three miles wide, with prairie immediately beyond. It appears, then, that river and lake exhalations favor tree vegetation; and to this influence, continued ever since the Mississippi had an existence, we may, perhaps, in good part ascribe the miscellaneous forest and luxuriant herbaceous vegetation, and the rich soil, which distinguish the Bluff-zone from the zones which lie immediately east of it; and which, at the same time, render its inhabitants more liable to autumnal fever.

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## SECTION XI.

### THE BLUFF-ZONE CONTINUED: VALLEYS OF THE BIG BLACK AND YAZOO RIVERS.

I. This section of the zone, east of the Mississippi and west of Pearl River, extends from that just described (the northern limits of which lie between the thirty-second and thirty-third degrees of latitude), up to lat. 35°. To the west, this section of the zone is limited, for a short distance, by the Mississippi, and afterwards by the Yazoo River; to the east, it is bounded by the upper waters of Pearl and Tombigbee Rivers. Like the three preceding divisions through which we have just passed, this section of the zone is narrow, especially in its lower part, where Pearl River, by a westerly bend, approaches near to the Big Black. Our paleontologists have decided, that the line of junction between the tertiary and the cretaceous formations of the south, traverses the lower extremity of this section, not far north of the town of Jackson, in the interior, and of Vicksburg, on the Mississippi; so that nearly the whole district on which we have entered, lies in the latter formation. As to civil divisions, no less than sixteen or seventeen counties, in whole or in part, are included within its limits. Those which make up its inferior portion,—Claiborne, Warren, Hinds, Yazoo, Madison, and Holmes,—began to be settled as far back as 1820, or even before; but the settlement of the remainder was at a later period.

As intimated by the heading of this article, two rivers drain the whole of this section. Big Black, the southern and shorter of these streams, originates in Choctaw county, and taking a south-west course, nearly parallel to the Yazoo, enters the Mississippi fifty-four miles below Vicksburg, near the town of Grand Gulf. The county in which this river has its origin, not less

than those through which it flows, is sufficiently elevated and rolling; but as the strata are loose and friable, it has scooped out, for the lower half of its course, a broad valley, with depressed and foul bottom-lands, densely overshadowed by tall trees. Even one of its tributaries, Baker's Creek, which I crossed in going from Vicksburg to Jackson, had a valley three or four miles wide, abounding in ponds and swamps; and a family near its banks were at that time, June 21st, afflicted with fever. At a higher point, where the Big Black separates the counties of Yazoo and Madison, its bottoms, as I was told, are wide, and subject to inundation. The Yazoo River originates in the northern counties of Marshall, Tippah, and Pontotoc, under the names of Cold-water, Tallahatchee, and Yallobusha; which streams, flowing to the south-west, descend into the wide Mississippi bottom, unite, and take the name of Yazoo. The course of this common trunk is nearly south, to the Mississippi, which it joins twelve miles above Vicksburg, and sixty-six above the mouth of the Big Black. Of the Sun Flower and other bayous, which are canals of communication from the Mississippi to the Yazoo River across the vast alluvial plain, an account has been already given. The course of the Yazoo is along the bluffs, which terminate this plain to the east, and constitute the western margin of the upland zone we are now studying. The main trunk of the Yazoo belongs, therefore, to the trough of the Mississippi, but the upland streams which form it, and the tributaries which enter its left or eastern side, belong to the bluff-zone, which, from Baton Rouge to Vicksburg, approaches the Mississippi, but is afterwards widely separated from it by the Yazoo Bottom.

This portion of the bluff-zone is nowhere quite level, and in some parts rather hilly. It has but few lakes or swamps, except in the immediate vicinity of its streams, and even these, as we advance to the north, diminish in width. One of the most important counties of this district is Yazoo, into which I traveled to Benton, twelve miles from Yazoo City. The country over which the road passes is elevated and uneven.

II. Benton has for its site a dry and rolling tract, with the low and swampy bottoms of the Big Black eight or ten miles to its east and south-east. The soil of this region is fertile, the natural vegetation miscellaneous, the water of the springs and wells much better than in the bluff-zone further south. Notwithstanding the country at and around Benton does not seem, in any great degree, to favor the production of autumnal fever, that disease is a regular visitant, and often presents malignant cases.

III. Doctor Montgomery has lately published a paper on the Topography and Fevers of Carroll, Choctaw, Tallahatchee, and Yallobusha counties, north of Benton, from which I make the following extract:

"In the above mentioned counties, the face of the country is very much interrupted and broken; the valleys in all, except the western border of Carroll, are very narrow, and confined and contracted by sandy and rocky ridges; no lakes of any importance, very little land subject to overflow, very few



ponds of stagnant water, or any place that could be properly called a malarious swamp. The Big Black River touches the south-eastern border of Carroll, and courses through the midst of Choctaw, from its north-eastern to its south-western extremity. There are but few creeks, and those of small dimensions, in Choctaw; and the valleys and creek-bottoms are very small and contracted in that county. In Carroll, we have the Yazoo River, running nearly in a southerly direction along our western border; the Tallahatchee passes through about thirty miles of our north-western corner; Big Black, as before mentioned, courses along the south-eastern angle of the county; thus, these three rivers run nearly from north to south, and the few creeks nearly all run westerly, to empty into the Yazoo. The creeks nearly all dry up in summer, and we have scarcely any ponds of stagnant water. The county of Yallobusha is only coursed by one river, the Yallobusha, which traverses that county from the north-east, running down to the south-eastern extremity, then turning and coursing all along the southern border. There is one large creek, bearing the euphonious name Attatambogue, which traverses the whole county, running from north to south; and it is worthy of remark, that the people living near the bank of this creek are very exempt from disease. There are a few more small creeks in this county, but of pure, clear water; and no malarious regions of any extent to my knowledge.

"We see, then, from this imperfect geographical outline, that the only local causes of disease in these counties, are from the Big Black in the south-east, the Tallahatchee and Yazoo on the west, and the Yallobusha running westerly from Choctaw, between Yallobusha and Carroll counties. As I have said, all this region, except the Yazoo valley in the west, is very much broken; the soil is rocky and sandy on the hills; the level lands are composed of productive dark-colored loam, with a sub-stratum of clay soils; some freestone, but little limestone; the springs of water are plenty and excellent, mostly rising in sandy strata, some few containing large portions of iron and sulphur. The highlands, by far the most plenty, are covered with the common pine, black jack, and red oak; the valleys are timbered with the gums, poplar, hickory, ash, white oak, elm, beech, &c. There is some little cane in the Yazoo valley."\*

IV. North of these counties we come to the culminating line between the Tennessee River, belonging to the Ohio Basin, and the Yazoo River. This water-shed is a westerly continuation of the hill-country of Alabama, but less elevated and not so rugged. Towards its eastern limits some portions are said (by Besançon †) to reach the altitude of eight hundred feet. It abounds in springs. Some of its streams have rapid currents, but others meander through wide bottoms which they overflow. The soil is generally rich, yet certain portions abound in pine, the indication of comparative

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\* New Orleans Journal, Vol. I., No. 6, p. 538.

† Annual Register.

sterility. In this region, as in the whole bluff-zone down to the Delta of the Mississippi, there are canoe-brakes. Besançon informs us that limestone is found in some of the north-eastern counties, which probably belongs to the coal formation; but those nearer the Mississippi are cretaceous. I will, however, reserve some remarks on the medical geology of this region, until after we have traveled over the next.

Autumnal fever is an endemo-epidemic of all parts of the zone drained by the Big Black and Yazoo Rivers; in some localities recurring every summer and autumn with violence, in others, as an occasional scourge.

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## SECTION XII.

### REMAINDER OF THE REGION SOUTH OF THE OHIO BASIN.

I. To conceive clearly of the form and extent of the remainder of the bluff-zone, which is the residue of the great region east of the Mississippi and south of the basin of the Ohio, it is necessary to refer to the remarkable course of the Tennessee River, the southernmost and longest tributary of the Ohio. At the sources of the Yazoo, or the northern limit of the tract we have just surveyed, a little below the thirty-fifth degree of north latitude, the Tennessee River comes within one hundred and twenty miles, in a direct line, of the Mississippi; but it then turns northerly, being deflected by the highlands of Alabama. This northerly course it continues, passing out of the state of Tennessee, and then across the western part of Kentucky, to the Ohio River at Paducah, above the thirty-seventh parallel, and thirty miles in a straight direction from the Mississippi. Throughout this lower section of the Tennessee River, which, by the meanders of the stream, is about two hundred and fifty miles, it receives from the region between it and the Mississippi none but the shortest tributaries; for the water-shed between these two rivers, is everywhere very near to the Tennessee. From this dividing ridge, or culminating plateau, much larger streams, however, descend westwardly to the Mississippi. The most southern is Wolf River, which, in its origin, interlocks with the Tallahatchee branch of the Yazoo, and finally joins the Mississippi at Memphis, Tennessee. Next, advancing north, we have the Big Hatchee, which likewise rises, in part, from the same summit, and, by a circuitous course, enters the Mississippi at Randolph, sixty miles higher up. Then succeeds Forked Deer River, and lastly Obion River; after which, up to the Ohio River, there is no stream worthy of being noted. Such is the hydrography of the district we are now studying. Politically, it comprehends the western district of Tennessee, and the western extremity of the state of Kentucky. Its surface is either level or undulating, except near the streams, and between their sources and those of the tributaries of the Tennessee, where it becomes more elevated and hilly. Every part of it belongs to the cretaceous formation, which, however, must be very thin in its northern margin. The rivers are sluggish in current, and, flowing through a loose surface, have excavated wide

troughs, with low alluvial bottoms, which are liable to frequent inundations. In traversing this tract from Memphis to Savannah, on the Tennessee River, the road passing through Raleigh, Somerville, Bolivar, and Purdy. I found the soil generally red, and where the streams had cut down forty or fifty feet, their banks exhibit the same hue quite to the water's edge. The stony fragments, in which the loam abounds, seem to prove that the latter is a decomposed conglomerate or pebbly sandstone; while the color of the soil shows that oxyde of iron was the cement. Stone of that kind is here seen *in situ*, increasing in quantity as we advance farther from the Mississippi. A notice of two localities—one low down and the other high up—on the Big Hatchee, will serve as specimens of the district.

II. Tipton County.—Doctor Harper\* has given us a sketch of the medical topography of this county. Bounded on the west by the Mississippi, it is traversed nearly through its center by the Big Hatchee. The river, and its tributaries, are bordered by low bottoms, from one to two miles wide, which are bounded by high banks on either side. The streams are crooked, and in winter and spring overflow the bottom-lands, which are mostly too wet for cultivation, and remain covered with their original forests. For ten miles from the Mississippi, the surface is hilly; but the eastern part of the county is more level, and is the chief seat of cultivation. This county is subject to autumnal fever; often congestive or malignant. It prevails more in latter years, than when settlements were first made; and more in dry summers than wet.

III. Bolivar.—This town, the most important of the interior, is situated sixty-five miles east of Memphis, on the south or left bank of the Big Hatchee, from which it is distant one mile. It stands on a plain, that slopes gently to the river; which is a deep, sluggish canal, not more than one hundred feet in width. Although between two and three hundred miles, by its meanders, from the Mississippi at Randolph, steamboats ascend it to this point. The bottom is here a mile wide, and subject to deep inundations. A dense forest, embracing cypress trees, overshadows it. Beyond this alluvium the land rises to the height of from eighty to one hundred feet, and presents ledges of perishable sandstone and conglomerate. The wells, in Bolivar, are from sixty to seventy feet in depth, and afford much better water than those of the cretaceous region, further south. The following strata are generally passed through, in digging: 1, Clay or loam, from five to fifteen feet; 2, red sand, from fifteen to twenty feet; 3, very white sand, from fifteen to twenty feet; 4, red and white sand mingled, but ending in pure white, with excellent, soft water.

IV. Doctor Higginson, of Somerville, speaks as follows of the whole Western District:†

\* Western Journal, Louisville, Aug., 1846.

† Transylvania Journal, Vol. VIII, p. 39.



"The face of the country is generally uneven, presenting a variety of hill and dale, sufficient to give a pleasing diversity to the eye. Approaching the eastern portion, the land becomes a little more broken, assumes a bolder feature, and presents an approximation, in character, to the mountain scenery on the other side of the Tennessee River. This feature obtains, in some degree, along the Kentucky border, and down the Mississippi River to some extent, until it is lost in the beautiful undulations, scattered over the general face of the country.

"The whole country, so far as geological observation has extended, is of secondary formation, composed of layer upon layer of loam, and clay, and sand, intermingled with various kinds of earth, and shells, and vegetable substances, disposed in such manner, as to induce the idea of being deposited at distinct epochs of the earth's history. In passing through different strata of sand, it is not unusual to find siliceous pebbles; as if they had formed a river or an ocean's bed, and had assumed their present form by long-continued attrition. The impression of twigs and leaves is common in clay; and, not unfrequently, the trunks of trees, changed to a kind of bituminous substance, are found at the distance of forty or fifty feet below the surface of the earth.

"Rivers are numerous here; perhaps no country on the globe is more liberally supplied with navigable streams than this. Sandy and Beach Rivers flow into the Tennessee, on the east; Wolf, Loose Hatchee, Big Hatchee, Forked Deer, and Obion, into the Mississippi, on the west; these, having their sources in, or passing through, some portion of the district, afford advantages to the farmer and merchant, rarely equalled in any part of the world. There is no point more than twenty-five miles distant from a navigable water-course. Creeks and rivulets, of sufficient size to propel machinery, are to be found in almost every neighborhood; sometimes, however, in dry seasons, they become deficient, on account of the absorbent quality of the soil. Dry creeks, as they are called, are scattered over the whole country; they wind their way among the hills, and continue flush until June, when they become dry, and remain so until the winter rains set in; with the exception of here and there a pool, standing in the deeper part of their beds. They are attended by little or no swamp or marsh; but by a strip of rich, level land, that becomes sufficiently drained for cultivation, by the planting season. The perennial streams carry along with them a low, paludal land, from a half to four or five miles in breadth, corresponding, in some measure, to the size of the water-course. This land is frequently inundated to its full extent by spring freshets, and on the recession of the waters, numerous sloughs and lakes are left, that remain stagnant, until drained or carried off by a slow evaporation.

"These low grounds give origin to a heavy growth of forest trees and shrubbery, that almost excludes the solar rays. The atmosphere is consequently heavy, and loaded with exhalations from decomposing animal and

vegetable matter, left by the retiring waters. On the higher lands, the forest is not so heavy, and under-brush less abundant; until here and there a patch of barren ground is presented, with scarcely a sufficient growth for the uses of husbandry. This obtains, to some extent, over the whole district, and is much sought by the planters, particularly when situated adjacent to lands heavily timbered, and yielding the supplies requisite for farming purposes. Small prairies are here and there found, which appear to have been produced by an extension of the same natural causes with the barrens. They both are light, and porous, and fertile; both alike suited to vegetable nutriment; both equally adapted to the growth of cotton, the different grains, and grasses; and no geological distinction can be detected, sufficient to account for the absence of forest trees. In their immediate neighborhood, good spring-water is generally scarce; probably owing to the direct rays of the sun on an alluvial soil, favoring an evaporation so rapid as to prevent that absorption and percolation of water necessary to the formation of springs. Good well-water may, however, be procured in almost every part of the country, at the distance of thirty or forty feet. This is of the temperature of sixty-two degrees Fahrenheit, and is considered more wholesome than that of springs. Whether this is owing to the greater purity of the one, or the low marsh-land usually accompanying the other, is a point in question. Certain it is, that families using well-water are more exempt from disease than those using the water of springs. There is in the vicinity of Somerville, a fine, bold spring of clear, freestone water, from which the citizens of that village were supplied for some years after its first settlement; during which period it was unhealthy. Diseases of a violent and dangerous character prevailed, particularly in the summer and fall of 1826; almost every case that occurred proved fatal. Since then, well-water has come into general use, and the village is comparatively healthy; diseases are less common, and of milder character than before. A greater improvement has taken place in this respect, than may be ascribed to modes and habits of life."

To this comprehensive account may be added a briefer notice, from another physician of the same district: \*

"The Western District," says Doctor Travis, "is generally a low country, abounding in many water-courses, upland ponds, and extensive marshy bottoms, on each side of every river, creek, and branch. The rivulets, in general, have but little fall. Mill-ponds are common; and, in consequence of the level surface of the earth, immense bodies of land are covered with water. The soil is fertile and covered with vegetation." According to Doctor Travis, intermittents of a malignant type are among the varieties of autumnal fever in this district.

In addition to these authorities I may add, that all parts of the region we

\* Transylvania Journal, Vol. I, p. 423.

are now exploring are subject to autumnal fever; but, with the exception of some localities, it is less frequent and fatal than in regions further south.

V. COTTON LIMIT.—In the Western District we have the northern limit of cotton cultivation. The thirty-sixth degree of latitude is that at which it ceases to be a reliable and profitable crop; though its cultivation, in a limited way, extends half a degree further north. Thus cotton bears to the thirty-sixth parallel, nearly the same relation which the sugar-cane bears to the thirty-first—the climatic difference between them being five degrees. In the larger towns of the sugar-zone, yellow fever is, *apparently*, an endemic disease; beyond that belt, an occasional epidemic; but it has not yet reached the northern boundary of the cotton-zone.

### SECTION XIII.

#### A GEOLOGICAL SECTION.

I. In concluding the topographical description of the country east of the Mississippi and south of the Ohio Basin, composed almost entirely of the cretaceous and tertiary formations, it will be acceptable to the medical geologist to have a summary of the original observations of a traveler,\* extending from Troy, in Obion county, Tennessee, N. Lat.  $36^{\circ} 20'$ , a few miles north of Obion River, to Centerville, Alabama, on the Cahawba River, in Lat.  $33^{\circ}$ ; the general course of his route being south south-east.

Around Troy, the country is level or a little rolling, and the wells reveal nothing but clay, which is so tenacious that no curbing is needed. Beginning somewhere north of that town, and extending to Cold-water River, in the state of Mississippi, one hundred and thirty miles south, Mr. Christy everywhere saw the same upper stratum, which he has designated as No. 1. It consists of a heavy deposit of clay, which includes beds of leaves, black dirt or mud, and logs or trunks of trees, not petrified. Obion, Forked Deer, Big Hatchee, and Wolf Rivers, have their troughs in this stratum. Beneath it is a stratum of sand, No. 2, about one hundred feet thick, which presents white, red, and yellow layers, and includes, in irregular dissemination, beds of gravel and pipe-clay. When wells are sunk through this stratum of sand, the quantity of water is so great as to indicate a subterranean stream. Cold-water River has cut its bed so deep into this stratum, as to draw a large supply from it; and hence, perhaps, that temperature which suggested its name. In some places, these outbursts of water have the diameter of a hoghead. The upper stratum of clay, No. 1, extends to near Holly Springs, Marshall county, Mississippi, but is attenuated, and only found capping the low eminences of the sand stratum, No. 2. This stratum extends as far south as the Tallahatchee River, in the southern edge of the county just

\* *Lectures on Geology.* By David Christy, Oxford, O., 1848.



named, where it is cut through by the river, and a lower bed, No. 3, is exposed, consisting of clay, including thin strata of ferruginous sandstone, and occasional beds of iron ore. It also contains trees which are silicified. Beneath this, in the same locality, is a stratum of sand, with beds of massive sandstone, in its lower part;—this is No. 4. A stratum of clay, constituting No. 5, is found in the same locality, imbedding lignite, black mud, and impressions of leaves. Pontotoc, Mississippi, between the sources of the Tallahatchee and the Tombecbee, stands on this, which is a pine-bearing stratum. Below this deposit, is No. 6, a thin bed of sand; then, No. 7, a bed of clay; succeeded by No. 8, a marly clay, with beds of limestone, and unconsolidated marine shells. No. 9 is red sand; on which follows No. 10, the great deposit of marlite, or rotten limestone so often mentioned. Its first appearance is a few miles south of Pontotoc. From this town to Houston, thirty miles directly south, the road is over Nos. 8, 7, 6, and 5. At Houston, No. 9 makes the surface, and No. 10 is only twenty feet below. From Houston to Starkville, thirty-seven miles, still nearly south, No. 9 is uppermost for more than half the distance; when No. 10 rises so high, that the other is only found capping the hills. Mr. Christy had now reached the great cretaceous soft or rotten limestone formation, which stretches from Oetibbeha county, of which Starkaville is the seat of justice, and Lowndes county, of which Columbus is the chief town, round to the Alabama River. He traced it through the prairies, to Centreville on the Cahawba, and made many observations on its mineral, as well as its paleontological character; but, as we have already said as much concerning it as etiology seems to require, we shall not follow him further.

II. CONCLUSION.—In concluding this chapter, a few facts deserve to be reproduced to the reader:

1. The whole region which has been surveyed, lies south of the thirty-seventh degree of north latitude, and its broadest part is in the thirty-second;—it is, therefore, a southern region.

2. Its elevation above the Gulf of Mexico is but small, not averaging more than four hundred feet.

3. It has an inclination to the south; which is true even of those parts which discharge their waters westerly and south-westerly into the Mississippi.

4. It is composed of the (geologically) recent cretaceous and tertiary formations, which are friable in texture and miscellaneous in composition, still containing remains of organic matter.

5. As a consequence of this structure, its streams have wide alluvions, and sluggish currents, which lead to frequent valley-inundations.

6. It is undeniable, that this great region is more generally and seriously infested with autumnal fever, than any other portion of the Interior Valley of North America.

7. Most of it has been settled within the last thirty years, and new plantations are still forming.

It is, therefore, what we, provincially, call a new country, and with the progress of cultivation, may become much healthier. Most of its streams, however, will long continue to overflow their low, broad, alluvial bottoms, and thus thread the higher lands with lines of pools and swamp, which, under the influence of a southern sun, will of necessity send forth the efficient cause of autumnal fever. The question, moreover, may be raised, whether, in summer and autumn, there may not be telluric emanations, from the unconsolidated strata of the comparatively recent tertiary and cretaceous formations, which the older carboniferous, Devonian, and Silurian formations do not send forth. I would not venture to answer this question affirmatively; but if such be the case, the region we have surveyed is permanently exposed to an additional cause of insalubrity.

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## CHAPTER IX.

### THE SOUTHERN BASIN, CONTINUED.

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#### MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE MISSISSIPPI: THE OHIO BASIN.

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##### SECTION I.

###### LIMITS AND GENERAL FEATURES.

In entering this basin, we rise from The South-West to The West, into the region which, thirty years ago, was, in common parlance, called the Valley of the Mississippi; for, at that time, the settlements beyond that river were exceedingly limited, and most of those in the south-west were but beginning. The central states of the Ohio Basin are Kentucky and Ohio. The former, except its farthest western extremity, which rests on the Mississippi, is more entirely within the Ohio Basin than any other state. To the south of Kentucky, the state of Tennessee, the northern end of Alabama, the north-west corner of Georgia, and a larger portion of the south-west angle of North Carolina, lie within this basin; to the east of Tennessee and Kentucky, other portions of North Carolina, and the whole

of Western Virginia, belong to this basin; east of the state of Ohio, the western third-part of Pennsylvania, and a portion of the south-west corner of New York, dip into the same basin; the northern part of Ohio, and, west of it, of Indiana and Illinois, likewise appertain to the Ohio Basin, of which the western limit runs through the state of Illinois from north to south, so as to include about a fifth-part of that state. Thus, while no single state lies entirely in this basin, Tennessee, Kentucky, Indiana, and Ohio are chiefly in it, and constitute what is, or was formerly, called *THE WEST*. In addition to these, eight other states discharge a portion of their waters through the Ohio River; making in all twelve states, which are hydrographically connected with this basin. Of all the basins of the Great Interior Valley, this approaches nearest to a circular figure; its central and intersecting diameters conforming to the cardinal points, and being nearly of the same length. Its center would be included within a line drawn through Maysville and Lexington, Kentucky; Madison, Indiana; and Cincinnati, Ohio; between the thirty-eighth and thirty-ninth parallels, and the eighty-fourth and eighty-fifth meridians. Its most southern latitude, on the highlands beyond the great bend of the Tennessee River, is in the state of Alabama, about thirty-four degrees and fifteen minutes; its northern, in New York, a little above the forty-second degree. In longitude it ranges from about seventy-eight to eighty-nine west. The former of these meridians runs through New York and Pennsylvania, at the sources of the Alleghany River; the latter passes through the mouth of the Ohio River.

The Ohio Basin differs, in many respects, from the more southern basins over which we have traveled. Its general elevation above the level of the sea, excluding its mountains, is more than twice as great as the regions we have just left—that is, from seven hundred to one thousand feet; while the mountain borders to the east and south-east, rise from two thousand five hundred to five thousand feet. The north-west portions, in Illinois, Indiana, and Ohio, embrace tracts of level land, not unlike the plains of Alabama; but south of the Ohio River, the surface is everywhere ridgy, rising eastwardly into the mountainous; a character which belongs equally to the eastern portions of the region north of the Ohio.

Geologically, the difference is equally great. A very small part, near the mouths of the Ohio and Tennessee Rivers, presents the cretaceous formation, on which we have dwelt so long; all the rest offers at the surface older geological formations. The western, southern, and eastern parts embrace extensive coal deposits, with their accompanying sandstones, shales, and limestone; the central portions show at the surface Devonian sandstones and shales, of an older geological date; and large tracts of Silurian limestone, still older in the geological series, are found at the surface; the carboniferous and Devonian formations seeming to have been washed away. The oldest of these Silurian or transition rocks bulge up in, and a little south of, what has been designated as the geographical center of the basin. The rocks



of these various formations are firmly indurated, compared with the eroceneous and tertiary deposits, and have, therefore, been acted upon much less in a lateral direction. Hence most of the valleys are mere ravines, compared with those which have been excavated through loose and friable strata. This is especially true of that part of the basin which lies south of the Ohio River. To its north, however, in Illinois, Indiana, and Ohio, there are deep and extensive deposits of drift or diluvium, in which the streams have excavated wide valleys, and formed alluvial bottoms of corresponding breadth. All parts afford springs, though not of equal copiousness and permanence, and well-water can everywhere be obtained. The creeks and rivers rise rapidly, and the range between low and high water is great. In the northern margin of the basin, there are many small lakes, or, more properly speaking, large ponds, and numerous swamps of still greater area; but in the basin generally they are not found.

To the north of the Ohio, in Illinois, Indiana, and Ohio, there are considerable tracts of prairie; but the basin generally presents, or did present, compact and lofty forests, composed of the diversified tree vegetation of the fertile soils of the middle latitudes. The pines, hemlocks, and other resinous trees, are chiefly found in the mountains of Western New York, Pennsylvania, and Virginia.

As is implied in the name given to this basin, its great river is the Ohio, the general course of which is west south-west. Its principal tributaries on the north side, beginning with the lowest and ascending, are the Wabash, Great Miami, Scioto, Muskingum, and Alleghany; which last is, in fact, the Ohio, under another name. On the south side we have, beginning with the highest and descending, first, the Monongahela, the junction of which with the Alleghany, at Pittsburgh, forms the Ohio; then the Kenawha, the Sandy, Kentucky, Green, Cumberland, and Tennessee. As a general fact, the rivers on the north side have a shorter course and a more rapid descent, than those of the opposite side of the Ohio.

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## SECTION II.

### TROUGH OF THE RIVER.

From the mouth of the Ohio to that of the Tennessee, that is, from Cairo to Paducah, the distance is forty-five miles, following the Ohio in its bend to the north. Through the whole of this section, which may be called the estuary of the river, the current is slack and gentle, indicating very little fall, except when there is a flood in the Ohio, and, at the same time, low water in the Mississippi. The river, in the lower part of the estuary, is expanded to a breadth even greater than that of the Mississippi where they unite. Its banks, for much of the distance from its mouth up to the Tennessee River, are low, and its bottoms so wide that no hills can be seen. Large

tracts are, of course, annually overflowed, early in the spring by the Ohio, later by the Mississippi, and occasionally by a simultaneous flood in both. These inundations leave ponds, and extensive swamps, heavily shaded with sycamore, cotton-wood, water-maple, and liquidambar, on both sides of the estuary. Here and there a clay or gravel bank, cretaceous, tertiary, or diluvial, rises above high-water mark; but in its rear there is, commonly, lower and pondy land. A ridge or terrace of this kind is seen for some distance, on the north side of the river, between Cairo and Paducah, producing none of a diminutive size, and having ponds in its rear. The only towns of any importance on the estuary are, Cairo, at the mouth of the river, already described when treating of the trough of the Mississippi, and Paducah, immediately below the mouth of the Tennessee River. The scattered inhabitants between these places, not less than the people of the former, are subject to autumnal fever, which occasionally shows a malignant character. The depression of this portion of the valley below the high-water level of the Ohio and Mississippi, must forever render it liable to this form of fever.

From the Tennessee River upward to the mountains, the banks are more elevated than below, and second terraces are everywhere met with. Even a third is occasionally seen. The former are rarely so low as to be reached by the highest floods of the river; the latter, of course, always above them. The first bottoms are mostly argillaceous, with a deep soil. The second and third consist largely of bowlders, pebbles, gravel, and sand, covered with a stratum of yellow loam, overspread with a thin layer of soil. Their surface is generally dry. The *debris* of which they are composed, are all water-worn to a polished surface, except those which obviously belong to the adjacent strata. The sand is almost invariably in the deeper parts of these deposits, while the other and larger masses are found nearer the surface; showing that they have been agitated by the fluctuations of stagnant water; a further evidence of which is, that the materials are, imperfectly, disposed in strata, which at considerable depths are variously curved and inclined, but near the surface are generally horizontal. Among the pebbles and small bowlders, there are fragments of all the different rocks yet discovered to the east, north-east, and north of the river; and the further we ascend it, the larger are these masses, and the more extensive the upper or second bottoms which they compose. In their depths, beds of tenacious blue clay are occasionally met with, and fragments of trees, with *unios*, and other fresh-water shells, of the existing geological era. Detached and water-worn teeth and vertebrae of the mastodon and arctic elephant are likewise found. Well-water of a hard and sometimes sulphurous quality, but generally palatable and salubrious, is obtained at various depths, from twenty to one hundred feet. In some places, where there is a third terrace, the *debris* are consolidated, by oxyde of iron, into a coarse, stratified conglomerate. All the beautiful town-sites and valley-residences along the Ohio, are seated on these old bottoms, which are called by the geologists

diluvial or post-tertiary deposits. The first or lowest bottoms, lying between these and the river, are sometimes wider, sometimes narrower than the second. They are generally composed, as already intimated, of clay,—yellow, reddish, or blue,—with more or less marl and sand. When the last is abundant, they are easily washed away. They also inclose fragments of wood, and detached bones, or even whole skeletons, of extinct as well as existing mammalia. The water they afford is often not so pure as that obtained in the gravel plains, and frequently contains the bicarbonate of iron. These low terraces, and also the higher and older, generally incline from the river, and hence the water which descends upon them from the hills, or falls in rain, does not flow directly to the river, but takes a course more or less parallel to it, forming swampy streams, which slowly discharge themselves into the hill-tributaries of the river.

In former times, these marshy brooks were dammed up by beavers, and converted into ponds, overshadowed by the forest, and half-filled with dead and decaying trees. The declivity of these, like that of other alluvial bottoms, was produced by the greater deposit of silt near the margin of the bank than further back. In ordinary floods, the river no longer passes over its banks, but throwing its back-water up the estuaries of its tributary streams, and into the beaver-creeks, spreads over the rear of the bottoms, producing on many of them a deep inundation, while a margin of dry land remains in front. When the flood recedes, a new deposit of silt and drift-wood is left, with sloughs and ponds, which dry up more or less rapidly, according to their depth and the degree in which they are fed by springs from the adjoining hills.

Such is the general character of the trough or immediate valley of the Ohio. It only remains to add, that this valley, from *hill to hill*, has a width which varies from one to two miles, and that, except where considerable tributaries enter, the bottoms are rarely of the same width on both sides at the same place, but present the wide and narrow in alternation. Of the hills it may be stated, that they generally rise about four hundred feet above the lowest level of the river, are steep, and divided by narrow ravines, but are covered with productive soil, and sustain a vigorous and lofty growth of forest trees. They constitute a rugged zone on each side of the river, which, at a short distance back, graduates into undulating or level land, until we ascend the river about six hundred miles, to the outcrops of the Appalachian coal formation, when the whole surface of the country becomes more broken.

Having made this general survey of the basin and trough of the Ohio River, we must now proceed to more particular topographical descriptions. In doing this, it will be proper to begin with the lower tributaries on the south side; as we shall then start from the terminal line of the last chapter. The localities along the Ohio River, will be described (as far as I



have materials) as we pass from the mouth of one tributary to that of another. We, of course, commence with the Tennessee.

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### SECTION III.

#### SOUTHERN OHIO BASIN : THE TENNESSEE RIVER.

I. The Tennessee River has sometimes been compared with the Ohio, which it almost equals in length, and in some places rivals in breadth; yet, to the medical topographer, the interest it presents is far less. Its sources, in the mountains of Virginia and North Carolina, are found as far north as the thirty-seventh parallel; which is that of its mouth, in the state of Kentucky; while its middle is bent down, in the state of Alabama, to the thirty-fourth degree. Through the first half of its course the Tennessee is, strictly speaking, a mountain river; but afterwards, it flows through a hill-country. For three-fourths of its length, the Appalachian Mountains, and the declining spurs which they send off, westwardly, across the state of Alabama, restrain it on the south; while the Cumberland River, which conforms to its great curve, approaches it so closely on the opposite side, as greatly to narrow its basin. Hence, after its formation by the Clinch and Holston, at Kingston, six hundred miles from its mouth, it does not receive a single tributary wide and deep enough for steamboat navigation. This limitation of its basin, taken in connection with a number of shoals and rapids, has combined with the hilliness of many parts of the country through which it flows, and the narrowness of most of its alluvial grounds, in retarding the settlement of its banks, and rendering their study an object of interest to the medical etiologist. From its mouth to its sources, the banks do not present a single town with one thousand inhabitants; nor is there a town within its basin that contains more than that number.

In continuing the description, we may conveniently divide this river into the Lower and the Upper Tennessee, taking the Muscog Shoals, between Florence and Triana, as the line of division. The length of the lower section is about two hundred and seventy-five miles. Through most of this distance, the country on each side is somewhat rugged, and composed largely of carboniferous limestone; which, however, is often found only in the bed of the river, while the hills are composed of, or capped with, the rotten or cretaceous limestone;—as I had an opportunity of observing, on the route from Memphis, through Purdy and Savannah, to Florence. The bottom-lands of this section of the Tennessee, are said not to be very broad; there is no great prevalence of ponds and swamps, compared with the rivers farther south; and their liability to autumnal fever is in correspondence with this topography.

II. FLORENCE, IN NORTH ALABAMA.—This town, one of the oldest in the basin of the Tennessee, stands on its right or northern bank, not far below the Muscog Shoals. Its site is on the southern edge of a considerable tract

of table-land, elevated from eighty to one hundred feet above the level of the river, free from ponds and sloughs, and subjected to cotton cultivation. Between the town and the river, which here runs from east to west, there is an alluvial bottom, a quarter of a mile in width, which is subject to inundation, and constitutes the chief source of autumnal fever in this locality. The inhabitants obtain their drinking-water from wells. They are dug to the depth of sixty or eighty feet, through loose materials—coarse red sand and clay, abounding in detached organic remains and moldering fragments of silicious stone. The water is soft, and of the temperature, in June, of sixty-one degrees Fahrenheit. Like other river towns in the latitude of thirty-five degrees north, Florence is visited annually with autumnal fever, which, however, is in general of a mild character.

III. **TUSCUMBIA.**—The plain on which Florence stands reappears on the south side of the Tennessee River, and stretches off eight or ten miles, to the mountain highlands, which constitute the water-shed between this river and the Coosa, which flows to the south. On this plain, the surface of which is gently undulating and of a reddish color, at the distance of four miles from the river, in the midst of extensive cotton-fields, stands the newer town of Tusculumbia. The most interesting object in the topography of this place, is a spring, which, almost in the center of the village, gushes from a ledge of carboniferous limestone rocks. The pool which it forms is beautifully overshadowed by trees; the water displays a bluish tint, and abounds in long wreaths of aquatic plants. Its temperature, in the month of June, was sixty degrees Fahrenheit. In flowing off, it expands into a brook thirty yards in width, which very soon joins itself with a surface-stream; and the united waters, under the name of Spring Creek, make their way, north-westerly, to the Tennessee River, three miles from the town. This creek, flowing through the loose upper stratum of the plain, has formed wide alluvial bottoms, which are occasionally inundated; and hence Tusculumbia has, to its windward, a permanent source of autumnal fever, from which it annually suffers.

IV. **THE MUSCLE SHOALS AND ADJACENT PLAIN.**—I did not visit the Muscle Shoals. Their length is sixty or seventy miles. The river is divided into many channels, in which the water is in some parts slack, in others rapid. Islands, of course, are numerous, and the breadth of the whole trough very great, compared with that above or below. To the south, through the whole length of the shoals, lies the plain on which Tusculumbia is built; and in traversing it for a distance of forty-three miles by the railroad, to Decatur, above the shoals, the low range of terminating Appalachian Mountains, which stretches across North Alabama, is everywhere in sight to the south. The width of this plain is from six to ten miles. Although it is, except near the river, above the highest floods, its surface is not free from ponds and sloughs; and its inhabitants, including those who live in the village of Courtland, are subject to autumnal fever.

V. **DECATUR** stands on the eastern edge of this plain, and is less eleva-

ted above the river than Tusculumbia or Florence. It seems to be free from special sources of disease, as far as the plain around it is concerned, but is not beyond the reach of sinister influences from the opposite side.

VI. ROUTE FROM DECATUR TO HUNTSVILLE.—The river at Decatur is nearly half a mile in width, with shallow and stagnant water in the summer. Its north or right bank is low, and the road passes for two or three miles over a causeway, in the midst of foul ponds, lagoons, and swamps, left by the spring inundations of the river;—beyond this bottom, it mounts on table-land of the same kind with that on the opposite side of the river. From this plateau, which is several miles in width, the road rises to the summits of a tract of low hills; from the north-eastern edge of which, we look over the plain, on which stands the most noted and beautiful town in the Tennessee Basin—Huntsville.

VII. HUNTSVILLE is environed by spurs and off-sets of the Cumberland branch of the Appalachian Mountains, which repose around it in blue masses. This town enjoys the advantages of a fountain as pure and copious as that of Tusculumbia. Its surplus water is made to supply a canal, which is conducted along its valley, in a southerly direction, to the Tennessee River,—a distance of twelve miles. In this valley and the smaller lateral valleys opening into it, there is much drowned bottom-land, and, consequently, the people of Huntsville are not without annual visitations of autumnal fever, some of which are severe. There is no town in the south-west, the streets of which are better protected from the sun by shade-trees than this. In Mississippi and Florida, up to north latitude thirty-three degrees thirty minutes, the pride of China (*Melia azedarach*) is the prevailing shade-tree. Here, as at Memphis, about the thirty-fifth degree, it is replaced by our native white-flowering locust (*Robinia pseudacacia*), the branches of which are longer and tougher than in the higher latitudes.

VIII. MONTE SANO.—The insulated and conoidal mountain which has (not inappropriately) received the attractive name of Monto Sano, rears its head in sight of Huntsville to the east. By two barometrical admeasurements, Doctor Thomas Fearn has determined its altitude to be ten hundred and ninety feet above the town, which itself cannot be less than six hundred feet above the sea, making the positive elevation of the mountain nearly seven-teen hundred feet. Resting on carboniferous limestone, it belongs to the coal formation, and presents thin strata of that combustible amid its sand-stones and shales. About nine hundred feet from its base, a copious spring bursts out on its northern declivity, the temperature of which, in June, was fifty-four degrees Fahrenheit. Taking the heat of the spring below at sixty degrees Fahrenheit, we have a diminution of one degree of temperature for one hundred and fifty feet of ascent. The zone at the altitude of the upper spring sustains nearly the same vegetation as the banks of the Ohio in the latitude of thirty-eight and thirty-nine degrees, where the mean temperature of the year is about fifty-four degrees. The summit of the mountain pre-



fronts a limited plateau or table, from the margins of which, on every side, we look down into coves and valleys, where it often rains, as I was informed by Doctor Fearn, from clouds which do not rise as high as the mountain.

Such is the lofty, picturesque, and salubrious summer-retreat of the people of Huntsville, who have erected many hot-weather cottages upon it. They do not, however, entirely escape the fevers of autumn; for, in rainy seasons, those maladies have sometimes invaded their summer asylum.

IX. WHITESBURG.—Doctor Capshaw\* has given us a sketch of the topography of this small cotton-shipping town, situated on the right bank of the Tennessee River, eleven miles from Huntsville.

"The country in this vicinity is diversified; on the east we have a ridge of mountains making in toward the river, while to the north and west are a few scattering spurs and knobs, rising from a general plain but little elevated above the banks of the river. The plain is so much cut up with ponds and sloughs, as to have given currency to the local appellation of *Pond Beat*. During high tides in the river, about one-sixth of the surface is subject to inundation. The lands not occupied by mountains, and free from overflow, are generally of good quality, and mostly reduced to cultivation. The inhabitants number about nine hundred, two-thirds of whom are slaves, employed in the production of cotton. The prevailing diseases are of malarious origin, and chills are so common that few are so fortunate as to escape them a whole year."

We must now leave this portion of the river, as I am under the necessity of conducting the reader along the routes which I traveled, not having materials for a full description.

X. ROUTE FROM HUNTSVILLE TO KNOXVILLE.—The road from Huntsville to Knoxville, in East Tennessee, passes through Winchester and McMinnville, both in the basin of the Tennessee River, to Sparta, on the head-waters of the Canoy fork of Cumberland River, in the eastern edge of Middle Tennessee. Its course is nearly north-east, and the outlying Cumberland ridge of the Appalachian chain is most of the way in sight, to the south-east or right hand. At first, the route lies through the broad valley of Flint River, a tributary of the Tennessee. The soil of this valley is a rich reddish loam, abounding in angular nodules of chert, once imbedded in rocks, which, having suffered disintegration, form the present surface. The staple of cultivation, as in other parts of this great bend of the Tennessee, is cotton. There are both natural ponds and mill-ponds in this valley, which, like other localities of a similar kind in the south, is infested with autumnal fever.

In ascending from it, and, at the same time, entering the state of Tennessee, in north latitude thirty-five degrees, the surface of the country becomes more rolling; and a graminaceous agriculture, with tobacco and pasturage,

\* Western Journal, Louisville, Vol. IV, p. 1.

replaces, to a considerable extent, that of cotton. Apple-orchards also become more numerous and more productive.

After crossing the upper part of Elk River, at Winchester, the road imperceptibly attains considerable elevation, over an off-set of the Cumberland Mountain; the red cotton soil of the Huntsville plain now disappears; and the descent into the basin of Canoy River, is made over a succession of beautiful terraces, called the *Pleasant Plains*, the surface of which is a yellow loam, with fragments of chert. Two springs, which burst out from ledges of carboniferous limestone rock, in north latitude about thirty-five degrees thirty minutes, had, in June, the temperature of fifty-six and fifty-eight degrees Fahrenheit. Near McMinnville the red soil, with nodules of chert, reappears. From the valley of Flint River to McMinnville, the country is generally dry, and appears to be but little infested with autumnal fever. From McMinnville to Sparta, it continues dry, and is more broken.

From Sparta, which stands near the base of the Cumberland Mountain, the route to Knoxville is nearly east. The mountain belongs to the coal formation, and the strata which it presents on its western side are nearly identical with those of Monto Sano. A spring, about two hundred and fifty feet above its base, had, at the end of June, the temperature of fifty-five degrees Fahrenheit; another, in one of the valleys beyond the first ridge, was fifty-six degrees Fahrenheit. A succession of ridges, with intervening ravines destitute of alluvion, at length brings us into a deeper valley, which separates the Cumberland Mountain from Walden Ridge. Some of the crests passed over are, from their elevation and sterility, incapable of producing Indian corn. From the summit of this ridge, which is composed almost entirely of sandstone and conglomerate, the very distant and elevated mountains of North Carolina, in which the Tennessee has its remotest origin, can be seen in smoky outline. The descent from this mountain is into the valley of Clinch River, which is reached, over a succession of low hills, at Kingston, where it unites with the Holston to form the Tennessee River. The valley is composed of transition or Silurian limestone. It need scarcely be stated, that from Sparta to Kingston autumnal fever is almost unknown; elevation, aridity of surface, and barrenness of soil opposing its production.

From Kingston to Knoxville, on the west side of the Holston, there is no mountain, but the country is, on the whole, hilly; yet some of the valleys are of considerable breadth, and, as they rest on limestone, support a luxuriant vegetation. They do not, however, abound in ponds and marshes.

XII. KNOXVILLE is situate above high-water mark, on the right bank of the Holston, and is not surrounded by marshes. There are, however, two mill-streams adjacent to the town, one above, and the other a short distance below, which have dams and ponds. It was, doubtless, to some particular condition of these ponds, that we should ascribe the fever which, according to report, a few years since, nearly depopulated the place, and of which the history has not, I believe, been written by any of its physicians.

Previously to that epidemic, Doctor Ramsay\* had read before the Medical Society at Nashville "An Essay on the Medical Topography of East Tennessee;" but he does not give us a description of the site of Knoxville, his residence, nor of any other locality.

XIII. The indefatigable state geologist of Tennessee, Professor Troost,† has shown that the whole of this region, east of Walden Ridge, consists of Silurian and other old transition rocks (chiefly calcareous), ending in the primitive. All the rivers above Kingston—the Clinch, and its large tributary, Powell's River, to the north; and the Holston, with its tributaries, the Tennessee (improperly so called), and the French Broad—may be regarded as mountain-torrents, converging to form a common trunk, the Tennessee, six hundred miles from its junction with the Ohio. Of the elevation of this sub-Alpine region above the level of the sea I cannot speak, except from estimate. It probably ranges from eight to sixteen hundred feet. But, to say nothing of the Cumberland Mountains to the west, it is surrounded from the north round to the south south-west by mountains, which attain an elevation varying from two to five thousand feet, leaving an open valley to the south-west. It is to the divergence of the Cumberland Mountains from the Appalachian group, as it advances southerly, that this great mountain cove (to borrow a term from the sea-shore) owes its existence, and constitutes a peculiar region, so well entitled to the attention of the medical etiologist.

Of this region, Doctor Ramsay, in the paper referred to, speaks in the following language: "The water-courses of East Tennessee are pure and transparent, and their currents rapid. There are no sluggish streams, and no swamps or marshes of any extent. The water is generally impregnated with lime, but springs of freestone water are not uncommon."

In reference to the autumnal fevers of East Tennessee, the same writer thus expresses himself:

"I have already observed that, during the first settlement of the country, there was generally a remarkable exemption of the inhabitants from disease. This is especially true in relation to *fevers*, properly so called. Intermittents during the period of autumnal insalubrity form an exception. These prevailed extensively; but the pyrexia being a state of comparative comfort, they received little attention, and remedial agents were rarely employed. But with the opening and improvement of the country, sources of disease have been multiplied, and with them fever has prevailed to considerable extent. It is not confined to the valleys and banks of large rivers; but the more elevated countries are annually visited with its severest forms. The fact, that fever prevails in districts where vegetable decomposition is inconsiderable, if not harmless, seems to invalidate the correctness of the theory which ascribes idiopathic fever to a miasmatic origin exclusively. I would

\* *Pennsylvania Journal*, Vol. V, p. 363.

† *Geological Reports*.



not be understood to deny, *in toto*, that marsh miasm is the cause of fever; but since they prevail with us in a degree no way proportionate to the extent or concentration of the malaria, I must avow my scepticism of the adequacy of the cause, to the production of such extensive and powerful results. Intermittents are generally mild and manageable. Remittent fever is often violent and obstinate."

Since the publication of Doctor Ramsey's paper, another has appeared, from the pen of Doctor Cunningham, of Jonesboro,\* the most eastern town in Tennessee, from which I make the following extract:

"East Tennessee, bounded by North Carolina on the east, and extending to Cumberland Mountain westward, embraces some two hundred miles in length. From the mountains on its southern border, to the line dividing it from Virginia and Kentucky, it has a medium breadth of fifty miles. It is interspersed with mountains and valleys, and every intermediate variety of surface and geological structure.

"In the highest parts of the upper counties, it presents high ridges and precipitous mountains, with a small proportion of valley, or even arable land. Here the rocky formation is principally primitive. The water is the purest freestone. The streams having rapid currents, speedily drain the soil which is almost destitute of marshes, and the dense forests and hills everywhere interpose to neutralize the action of heat in summer. Thus, miasmatic influence can hardly be said to exist at all. The atmosphere is consequently pure and salubrious, except from thermometrical and hygrometrical influence. Following the western slope, we find the country less precipitous and primitive, though still broken. Here agricultural industry has broken in upon and measurably dispersed the dense shades of the forest. The atmosphere is consequently less humid, but the country is more exposed to the scorching sun in summer, and to the bleak and chilling blasts of winter, and to the daily vicissitudes of our climate. In this region the geological structure is secondary or transition,—the water chiefly pure limestone, except on the waters of Lick Creek and Horse Creek, both of which streams collect from the southern and eastern declivities of Bay's Mountain. These streams, as well as some others, from their having percolated slate-rock, or soap-stone (which is the striking formation of that mountain, and of the region through which they pass), present constantly a muddy and impure water, unpleasant in taste, and possibly exert some influence on the health of the inhabitants, though until late years there was no marked evidence of this. The inhabitants, as far as we are informed, enjoy as good health as in other localities.

"But of late, the extensive marsh and meadow-lands bordering these streams, which were densely timbered, so as to obstruct the rays of the sun,

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\* Southern Medical and Surgical Journal, Aug., 1846, p. 456.

and prevent miasmatic effluvia, have been extensively cleared for cultivation. The overflowing from the heavy rains leaves pools of water, with a copious deposit of vegetable matter, which, when exposed to the summer heat, enters rapidly into decomposition. In addition to this, the sub-stratum is either slate rock, or clayey structure, through which water sinks with difficulty. It must, of course, dry up more by evaporation than by absorption; consequently, there is great increase of miasmatic influence, which readily accounts for the great increase of sickness which has prevailed there for the last few years. Still further down are some extensive plains, but the soil being porous, there is but little malaria. Yet on the rivers, affording, as they do, a greater expanse of surface, relaxed in currents, and in high tides during wet or rainy seasons overflowing their banks, they may leave standing water and a saturated soil composed of alluvial and vegetable matter. The climate is also hotter, and here may be the elements for the production of fever during seasons when their combination of causes is brought into full exercise. While it will appear that in the upper counties a large proportion of cases are fever, in their etiology they differ materially from those in the lower counties. Between the summit-level of Johnston county, imbedded in the highest mountainous region of the state, and the lowest point of East Tennessee, where the Tennessee River breaks through the Look-out Mountain, there is a difference in elevation of about one thousand feet. The mountain range bordering it on the south, recedes so as to leave the western counties of this division of the state open and exposed to the southern breezes of Georgia and Alabama, so that similar natural causes must to a good degree operate on both, and it is therefore reasonable to suppose their character of diseases would approximate each other more nearly than those of the two extremes of East Tennessee itself. But the producing causes of fever in the one, are very different from those of the other; hence we have confirmation of the (so to speak) polygeneric causes of fever; and if it be an axiom that cause and effect are steadily related to each other, it would seem fair to conclude, that a difference in kind, in development or character, and in treatment also, exists."

XIV. COMPARISON BETWEEN EAST AND WEST TENNESSEE.—When the lapse of time shall have put us in possession of a sufficient number of facts on the topography, climate, and endemic diseases of East and West Tennessee, to permit a full and accurate comparison, it will be found to possess as much interest as a comparison between any other two regions of the Great Interior Valley. These extreme portions of the state of Tennessee lie between the same parallels of latitude, one near the sources, and the other near the mouth, of the river which bears its name, though distant from each other about six degrees of longitude. East Tennessee has a solid basis of old crystalline or semi-crystalline rock; is hilly, rising into mountains; and has rapid creeks and rivers, with narrow alluvions, good springs, and few swamps or ponds. West Tennessee is based upon loose, crumbling, miscel-

laneous strata—cretaceous, tertiary, and alluvial—abounding in organic matters, and impregnated with the gases developed by their slow decomposition; has a comparatively level surface, overspread more or less with sloughs; its rivers and brooks have wide and wet alluvial bottoms, and their currents are sluggish; its springs are few, and its well-water generally impure; its elevation above the level of the sea is from a half to a fourth that of East Tennessee; and, finally, it is surrounded by plains, or low hill-lands, while the other is inclosed by mountains. The constitutions and diseases of people living under conditions so different as these, cannot, of course, be the same, although their latitudes are identical. In reference to autumnal fever, it is well known that it prevails incomparably more in the western than in the eastern locality.

XV. VOYAGES ON THE UPPER TENNESSEE.—Kingston, at the junction of the Clinch and Holston, is the lower head of steamboat navigation on the Tennessee River; Knoxville, on the Holston, thirty miles above, is the final terminus. From the latter town to Decatur, near the Muscle Shoals, the distance is about three hundred miles. At this time the settlements from Kingston to Triana, not far above Decatur, are too limited to render the banks of the river an object of interest to the physician. Much of the region through which it passes was, indeed, until lately, the habitation of the Cherokee Indians; and much of it, in Georgia and Alabama, not less than Tennessee, is too mountainous to admit of a dense population. On that very account, however, it will be a desirable summer and autumnal retreat for the people of the hot, humid, and malarious coasts of Georgia, Florida, and Alabama;—a change of altitude near their own homes, conferring all the climatic benefits of a distant and expensive voyage to the north. In connection with this change of air, they may enjoy the voyage on the Upper Tennessee River; which may likewise be commended to invalids of the higher latitudes, when desirous, as they should be, of seasoning their exercise with the condiment of wild, sequestered, and romantic scenery. All these advantages, however, are prospective rather than present, for the number of steamboats on the Upper Tennessee is small, and the difficulty of reaching that valley, great. When it shall be penetrated from south to north by the railroads which are in progress, or have been projected, the access to it will become easy; and from the vernal equinox to the summer solstice (through which the Tennessee will be navigable), we may expect, sooner or later, to see the invalids from various latitudes united in voyages of health and pleasure on the retired waters of the mountain river. I will show the probability of this anticipation by a brief notice of a descending steamboat voyage in the month of July. Below Kingston, the river, with a general bearing to the south-west, is exceedingly serpentine. The narrow plains, down to the water's edge, were at that time clothed in a luxuriant vegetation of the deepest green, and over the wooded hills in their rear, occasional glimpses were had of Walden Ridge on the right, and the more distant and



lofty peaks of Unaka Mountain, in North Carolina, on the left. Now and then the river expanded to three times its ordinary breadth, and was beautified with low, green islands, compressing the navigable channel into a canal, from the banks of which a cane-brake bent its long stems and tender leaves over the margin of the stream, while the low limbs of the overshadowing trees, drooping under the weight of their luxuriant foliage, sought relief by reposing on the clear waters. No valley could surpass the verdure and freshness of this scene; in the midst of which a grove of cypresses, towering above the lower ranges of the forest, presented a lattice-work of white limbs, which formed with the surrounding green a contrast of surpassing beauty. Continuing its course to the south-west, the river at length approaches, but does not enter, the state of Georgia. It is here, in the center of the Cherokee country, that the now abandoned missionary station of Brainerd lies, off at a short distance to the left. Then comes Ross's Landing, where the river turns directly to the south; and Look-out Mountain, blue, lofty, and precipitous, is seen a few miles ahead. To the east is the low and flat land through which the Georgia Railroad is to reach the Tennessee River, and in which branches of the Alabama River have their origin; while close at hand, to the left, Walden Ridge rises like a mighty rampart. As we neared the Look-out, the river seemed about to plunge into some deep and dark cavern beneath the rugged buttress which rose one thousand feet above us; but, after amusing itself for a moment with our bewilderment, the current wheeled rapidly to the right, and flowing for a short distance along the rocky foundations, turned still further round, and almost touched the channel through which its assault was made. Another instant brought us to a new position, and presented the side of the mountain we had just encountered, stretching far away into the state of Georgia; while before us, on the right, stood the lofty abutments of Walden Ridge, confronting, to the left, the high and rugged escarpment of Raccoon Mountain, and presenting a scene of calm magnificence and solemn grandeur, the memory of which can never fade away. In a moment we lost sight of the first, and running for a short distance along the base of the second, we entered the rent, or gap, between it and the third of these mountains, when we found ourselves in a rude, rocky gateway, with immense precipices on either side. Vast fragments had rolled down, and contracted the bed of the river to one-third of its usual width; its current was greatly increased, and huge rocks at the bottom gave to the water above that agitation which had suggested the appropriate name of 'Tumbling Shoals.' To them succeeded a pool of tranquil water; after which the mountain chasm suddenly narrowed still closer, and the whole river was poured into a deep channel not more than one hundred yards wide, down which it glided as on a smooth inclined plane. This is the 'suck' of the keel-boatmen: to which succeeded a spot where the water boiled and foamed, and then another in which the same commotion appeared in a less degree. The stream now assumed a calmer aspect, and wound its way

among the mountains, by which it is so pent up, that portions of it, now and then, take on the form and face of narrow Alpine lakes. As these scenes of beauty and sublimity began to die away, we found ourselves on a wide river, still bearing to the south-west to enter Alabama, after passing within a mile of the state of Georgia. The country now assumed a more cultivated aspect, with tamer scenery; yet, blue masses of the Cumberland Mountains, lying off to our right, occasionally reminded us of the shifting scenes of grandeur through which we had passed. The last object of interest which met our view, was the precipice called the 'Painted Rocks.' Rising, like a wall, on the right margin of the river, to the height of a hundred feet, and composed of the carboniferous limestone which forms the base of Monte Sano, disposed in horizontal layers, it displays the aspect of an immense fortification. From this point to Decatur, the low hills recede, and the river flows through bottom-lands which are liable to annual inundation.\*

XVI. SOUTHERN PORTION OF MIDDLE TENNESSEE.—About one half of Middle Tennessee belongs to the basin we are now exploring. Some account of its eastern part has been already given in the route from Huntsville to Knoxville. My personal observations on the remainder, were limited to a journey from Huntsville to Nashville, through Pulaski and Columbia, both of which lie within the basin of the Tennessee River. Doctor Buchanan, of the latter town,† has described the medical topography of this region more fully than my own opportunities would permit.

Its most important rivers are Elk and Duck. The former flows to the south, and joins the Tennessee at the Muscle Shoals; the latter holds a western course, and unites with the same tributary, as it crosses the state to the north. These rivers drain six or eight of the most populous and important counties of Middle Tennessee. Their basis is limestone—carboniferous to the south, Silurian to the north—generally covered with a thin layer of calcareous loam of a yellowish-red color, overspread with mold, which is thin on the ridges, but deep and black near the water-courses. The loose upper covering of the rocks seems to be, in a great degree, the result of their slow disintegration. No drift or transported materials are found in the district. Ponds and swamps, even of a limited extent, are but occasionally met with; and the alluvial grounds of the rivers and creeks, unlike those in the cretaceous and tertiary deposits west of the Tennessee River, are narrow, and not often inundated. In some places, the surface becomes hilly and elevated. Of the springs in this region, Doctor Buchanan speaks as follows:

"From the fact of our rock formations being all of carboniferous limo-

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\* This voyage was performed in company with Doctor Fearn and Doctor Breck, of Huntsville, LeRoy Pope, Esq., of Memphis, E. D. Mansfield, Esq., of Cincinnati, Mr. Tarvin, of Decatur, and several other gentlemen, all of whom had the same impression of its interest.

† Transylvania Journal, Vol. IX, No. 3.

stone, the springs are all impregnated, more or less, with lime; but they are very numerous; and, although not quite so pure and limpid as the springs of a primary region of country, are, nevertheless, cool, transparent, and refreshing. Gushing, as they do for the most part, from between two strata of rocks, or issuing from the base of a hill, their waters glide upon a rocky or gravelly bottom to the larger streams. The mean temperature of our springs, which I noticed at different times during the last year, is about fifty-eight degrees Fahrenheit. The temperature of the spring which supplies Columbia with water, was fifty-six degrees, about the first of June, when the temperature of the atmosphere was eighty-four degrees; in December it was fifty-eight degrees—temperature of the atmosphere fifty degrees; at several other times it was fifty-six degrees. Many other springs in the country were about the same; some were also as high as sixty-two degrees." \*

With all these favorable topographical conditions, this region does not escape autumnal fever, the chief sources of which are the water-courses. Although most of them have bottom-lands, not often overflowed to any great extent, yet, in summer, they become insalubrious. In times of drought they fall very low, and much of their beds becomes dry. Thus they are converted into a series of stagnant pools. Many of them, moreover, are arrested by mill-dams, often at short distances from each other, above which a great deal of decomposable matter is accumulated, to be exposed to the action of the sun, as the scanty supplies of water, in August and September, are evaporated. In the latitudes of thirty-five and thirty-six degrees, at an elevation of only five hundred feet above the sea, which is that of the beds of these streams, they cannot fail to generate autumnal fever.

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## SECTION IV.

### Basin of the Cumberland River.

I. **OUTLINES.**—It has been already stated that this river lies in the great bend of the Tennessee River, to which, in its general course and curvature, it conforms; yet it does not wheel so far to the south as that stream; and hence, while the extremities of both are in nearly the same latitudes, their middle sections are separated a full degree. The Cumberland, much the shorter of the two, has its source in the state of Kentucky, on the western declivity of the mountain whose name it bears; whence, flowing to the west, and then to the south, it dips into Middle Tennessee, the metropolis of which—Nashville—stands on its left bank. Having passed that town, it turns north-west, and comes, at length, within a few miles of Tennessee River, when it repasses into Kentucky, and, crossing that state, joins the Ohio River at Smithland, only

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\* *Loco citato.*



ten miles above the mouth of the Tennessee. Thus it drains much of Southern Kentucky, and the whole northern portion of Middle Tennessee. Its sources are in the Appalachian or Cumberland coal basin; its middle in the carboniferous and Silurian limestone; its termination in the margin of the Illinois coal formation. Having laid down the outlines of this basin, let us now ascend through it to the mountains. Immediately below its mouth is the town of Smithland, of which I am unable to give a topographical description.

II. THE CUMBERLAND BASIN, UP TO NASHVILLE.—The Cumberland River, traced from its mouth up to the city of Nashville, a distance of two hundred miles, is found to make its way through a hilly and wooded country. Its tributaries are generally short; especially on the south or left side, where they are limited by the proximity of the Tennessee River, until we ascend to the neighborhood of Nashville. The bottoms along this river are much narrower than those along the rivers of the south-west, and are not as liable to inundations. The beds and banks of the Cumberland, and of its tributaries, are, in general, rocky. Within the limits of its narrow basin, on its right or north-eastern side, in Trigg and Christian counties, Kentucky, we have the western limit of a peculiar tract, called 'The Barrons,' which will be described in connection with the Green River Basin.

III. NASHVILLE, the capital of the state of Tennessee, and the only city of the Cumberland Basin, stands on the left side of the river, in N. Lat.  $80^{\circ} 9' 33''$ , and W. Lon.  $86^{\circ} 49' 8''$ . Its site is an elevated platform, of blue Silurian limestone, identical with that of Cincinnati. The covering of loam and soil is so thin that the rocks of the streets have to be blasted, to make receptacles for the soil necessary to the cultivation of shade-trees. Originally this terrace sustained a grove of red cedars (*Juniperus Virginiana*), of which many trees and bushes still remain. On the southern part of the town-plot there rises a beautiful rocky, oval hill, overspread with the same unerring evidence of a dry and stony soil. The surrounding country, in that direction, is calcareous and rolling. Immediately below the town, to the west, there is a depression, in which a sulphur spring bursts out, and over which the waters of the Cumberland spread themselves in high floods. On the opposite side of the river, there is a bottom of considerable extent, too elevated to be overflowed. Thus Nashville is favorably situated, as to what are regarded as the sources of autumnal fever; and its exemption from the disease appears to be in correspondence with its topography.

The surrounding country, seen from the top of Cedar Hill, presents a rugged, beautiful, and spirited panorama. In all directions it displays that configuration which excludes swamps and every variety of wet surface; but suggests ravines, with lagging streams, which, in summer and autumn, are liable to insalubrious depression.

The settlement of Nashville, by emigrants from North Carolina and Virginia, was begun in the year 1784. Hence, being one of the oldest towns in

the Ohio Basin, the locality in which it stands, has passed through the transition stage from forest to cultivated field.

IV. RUTHERFORD COUNTY.—This county,\* one of the oldest-settled and most important of the state of Tennessee, lies to the south-east of Nashville; from which its principal town, *MURFREESBORO'*, is distant about thirty miles. Its basis is the blue Silurian limestone of that city, covered with a deeper stratum of loam and soil—the former a product of the disintegration of the rocky basis, the latter a result of the decomposition of the luxuriant vegetation natural to such surfaces. The aspect of this country is either undulating or level; but the surrounding country is somewhat knobby. Almost every part of it is intersected by the upper tributaries of Stone's River, an affluent of the Cumberland. These numerous streams are but scantily fed by springs; and, therefore, although flush in the rainy season, so as even to overflow portions of their narrow bottoms, they either dry up in summer, or are converted into lines of pools, which, in the language of Doctor Beeton, "are loathsome and disgusting to the sight, and offensively fetid to the smell." "About seventeen crooks, forks, and prongs," he adds, "unite to constitute the main river (Stone's), which runs in a north-west course across the county. These branches and crooks rise from almost every point, and run in as many directions to the main channel. Across them are perhaps thirty-five or forty mill-dams, besides many other obstructions, made for cotton-gins and fish-traps. The ponds made by these dams are longer in evaporating than where there are no such obstructions. Near them, when the summer and fall are unusually dry, there has been more sickness than in any neighborhood of the county; except where the farmers have made watering-ponds on their plantations, for the accommodation of their stock."

Such a locality, in the latitude of thirty-six degrees north, cannot escape serious invasions of autumnal fever; which Doctor Beeton has observed to be great, in proportion as a more than usually dry season reduces the water of the pools below its common summer-levels. Many cases are malignant.

V. WILSON COUNTY.—The late Doctor Hogg† has given the following summary of the topography of this county, which lies between Rutherford county and Cumberland River:

"Wilson county, containing an area of twenty-five miles square, is bounded on the north by Cumberland River, and intersected by twelve or fifteen small streams, at nearly equal distances from each other, running nearly a north course on the one hand into the Cumberland, and from south to south-west on the other hand, into Stone's River. The south south-east, and south-west sections of the country, after leaving the river ten or twelve miles, become hilly, or what we call very broken, terminating in an extensive ridge separating the small north and south streams which I have mentioned. In

\* Dr. Beeton, in the *Tennessee Journal*, Vol. V., p. 157.

† *Western Journal*, Cincinnati, Vol. I, p. 601.

common seasons, the small streams or creeks, from the last of July until the middle of November, become almost dry or stagnant; in consequence of which, the deposits from the previous floods are exposed to the sun during the hot weather. The soil on the high ground is rich and productive, wherever the rock does not project. The forest is luxuriant, and consists of beech, shell-bark hickory, elm, sugar-maple, walnut, and wild cherry; or of white, red, and Spanish oak, poplar, hickory, dog-wood, sassafras, and grape vines. The flat lands, which are not very fertile, are covered with oak, hickory, elm, ash, dog-wood, and cedar, with much grass and weeds."

Having given this sketch of the medical topography of Wilson county, Doctor Hogg goes on to state, that autumnal fever, sometimes of a malignant type, is one of its annual visitors.

VI. RESIDUE OF THE CUMBERLAND BASIN.—On the south side of the Cumberland River, from Rutherford and Wilson counties eastwardly to the Cumberland Mountains, through the counties of Warren, White, Overton, and part of Smith and Jackson, the country is rolling or hilly, at last becoming low-mountainous, and the streams are less liable to summer stagnation; ponds are few in number, and swamps still rarer. The river can scarcely be said to be alluvial, and its bottom-lands are narrow.

On the north side of the Cumberland, from below Nashville upward to the point at which the river passes from Kentucky to Tennessee, the basin is narrow, and has substantially the topographical characteristics of the southern side. In traversing Sumner county, northwardly, from Nashville, I found it rolling or hilly, and dry, with a sub-stratum of Silurian limestone, to the margin of the adjoining basin. East and north-east of that county, the surface gradually becomes more rugged, to the Cumberland Mountain, in which the river has its sources. At what stage of this ascent up the flanks of the mountain, autumnal fever ceases, I am not informed.

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## SECTION V.

### BASIN OF GREEN RIVER.

I. OUTLINE VIEWS.—The distance, along the Ohio, from the mouth of Cumberland to the mouth of Green River, is one hundred and thirty-five miles; but no town of any note stands on the left or southern bank of the river, except Henderson, with the medical topography of which I am not acquainted. The basin of Green River comprehends what is, by some, called Southern Kentucky, by others, the Green River Country, by others, the Barrens, from its embracing large tracts of undulating land nearly destitute of trees. The thirty-seventh parallel passes a little south of the center of this basin, the whole of which lies within the state of Kentucky, and belongs to the Illinois coal formation. Only the north-western or lower half,



however, contains beds of coal; the other rests on the carboniferous limestone, which underlies the coal measures.

The bed of Green River for some distance up, is bordered with rich alluvial bottoms, which are not, to any great extent, subject to inundation. The river, through nearly its whole length, has been converted into pools by lock-dams, of which, in reference to their influence on the health of the inhabitants, I cannot speak.

The surface of this basin is either undulating or hilly. In some places it verges on the mountainous, especially to the north-east, where Muldrow's Hill separates it from the basin of Salt River.

The Green River Basin is comparatively free from swamps; and its narrow bottom-lands are not, in general, so low as to be, by reason of inundations, uncultivable. There are, however, two sources of autumnal fever: *First*, The pools formed in the beds of streams nearly dried up in summer; *Second*, Natural and artificial ponds, preserved or made, to afford an adequate supply of stock-water.

As, on leaving the Tennessee Basin and entering the Cumberland, we find the cultivation of cotton decreasing, and that of the *gramineæ* increasing, so, in passing from the latter into the Green River Basin, about north latitude thirty-six degrees thirty minutes, the cotton-field is no longer seen, but is replaced by tobacco and hemp.

II. THE BARRENS.—When treating of the Cumberland Basin, a reference was made to the region called the 'Barrens,' part of which spreads into that basin, while the remainder lies in the one we are now studying. According to Doctors Owen and Norwood,\* this peculiar tract of country has for its sub-stratum the carboniferous limestone of the Illinois coal basin, overspread with a deep layer of loam, colored red with oxyde of iron, and abounding in fragments of chert or petrosilex, which were once imbedded in the rocks, whose gradual disintegration has generated the loamy covering.

I am indebted to my colleague, Professor Short, of the University of Louisville, for the following topographical description of this district.† Although his observations were chiefly made in the western part, I am assured, they are substantially applicable to the whole. The following is his account:

"When I first went to Hopkinsville, where I practiced medicine from 1817 to 1826, the aspect of the barrens was very much the same with that presented by the prairies of Illinois; and, I suppose, the characteristic feature of both—destitution of timber—is in both cases attributable to the same cause—the annual ravages of fire; which, fed by the tall grasses, and dead herbaceous plants, in autumn, is so intense as to destroy all the ligneous growth which may have sprung up during the preceding spring and summer. The vegetable productions of both these regions—barrens and prairies—

\* *Researches among the Prot. and Carb. Rocks of Central Kentucky.*

† MSS. *penes me.*

are very similar; the grasses being, for the most part, various species of *Andropogon* and *Panicum*, and the herbaceous vegetation consisting, chiefly, especially in autumn, of the various *compositæ*—*Silphium*, *Aster*, *Solidago*, *Eupatorium*, &c.; while along the water-courses, in both regions, the arborescent species are very much the same; as they are, also, in certain woodland tracts, called by the people 'groves.' This difference, however, obtains, between the barrens of Kentucky and the prairies north of the Ohio, viz, that the former are superimposed on a bed of limestone, which is wanting in Illinois. The limestone of the barrens, too, is of a peculiar kind, and very different from that of northern Kentucky. Instead of being regularly stratified, or disposed in horizontal layers, it seems amorphous and irregular; generally found at very different depths beneath the surface, and covered with a red, tenacious clay containing chert, or else projecting above the surface in misshapen blocks. This limestone, moreover, is exceedingly cavernous; and 'sinks,' or depressions, are frequently met with, which lead to apertures in the rock. Indeed, in many parts of this district, large streams disappear from the surface, take subterranean courses for miles, and again emerge into day. The barrens of Kentucky are, moreover, much more rolling, and uneven on their surface, than the prairies of Illinois; and you nowhere meet with those extensive tracts of level surface, so common in the large prairies of that state. By cultivation, and the prevention of destroying fires, the barrens are losing, yearly, their once peculiar features; for, no sooner are the fires kept out for a few years, than the surface becomes clothed with a dense growth of timber—oaks and hickories—so dense, indeed, as to stifle entirely all herbaceous undergrowth.

"*Marshes*, in the proper sense of that term, are exceedingly rare among the barrens. Indeed, within the limits of the three counties in which I practiced—Christian, Todd, and Trigg—I know of but one marsh of any magnitude; and that I shall never forget, from the circumstances of finding in it the *Cyperus luteus*, the most magnificent of all aquatic plants. Around the margins of this marsh, in the shallow, muddy water, were growing thickets of *Decodon verticillatum*, *Cephalanthus occidentalis*, *Rosa Carolina*, and other semi-aquatic shrubs.

"The streams, in the western part of the barrens, run in deep rocky beds; the banks being often precipitous, and ten or twenty feet above the ordinary level of the water; thus they rarely overflow their narrow bottoms. In fact, I do not know any part of that region which is inundated, except it be where the streams have been dammed for the erection of mills. There is, however, another source of marsh effluvia, that, no doubt, exerts a material influence on the health of the inhabitants; which is, the number of ponds, some of them natural, but many more artificial, which are found throughout the barrens; for no sooner are the apertures in the limestone closed, either by accident or design, than the 'sinks,' surrounding them become filled by rains; and the tough, red clay preventing all percolation, these ponds con-

time steadily to increase in area and depth, until, if not drained, they rise to the surrounding brim. In this way are these ponds constantly forming; and there is scarcely a farm to be found in the whole region, where a number of them do not exist, some to the extent of several acres. They are subject, of course, to various fluctuations, and expose a large surface of mud, as they dry up, in times of drought. The running streams, moreover, become very low, in the latter part of summer and in early autumn; but, as before observed, their beds being rocky, they are comparatively harmless, except where they are obstructed by dams.

"During the nine years that I resided at Hopkinsville, there was every year a very general prevalence of autumnal fever; beginning, commonly, in July, and continuing to October. The worst cases were an obscurely-marked intermittent form, attended by deep congestions of the viscera. They sometimes extended far into winter."

I am informed by my colleague, Professor Yandoll, who has lately visited the barrens several times on geological explorations, that the fevers of autumn are annually increasing; which he ascribes to the increase of ponds. Thus while the common, the legitimate influence of settlement and cultivation, is to abate the frequency and violence of our intermittent and remittent fevers, here, as an exception, is a district in which art has, undesignedly, contributed to their greater prevalence.

I shall extend this article no farther than to add, that the barrens extend westwardly, from near Glasgow, in Barron county, through Edmondson, Warren, Butler, Logan, Todd, Christian, and Trigg counties, to the Cumberland River, and embrace the towns of Bowling-Green, Russellville, Hopkinsville, and several others of less note.

III. THE MAMMOTH CAVE.—The barrens and the basin of Green River enjoy the distinction of including the celebrated Mammoth Cave, the most remarkable of the numerous caverns in which the limestone immediately beneath the Illinois coal formation abounds. The interest of this cave is not, however, to etiology, but to practical medicine; for it does not cause diseases, and has been proposed as a residence for their cure. It may, therefore, receive a notice in this work, with the same propriety that certain salubrious localities and regions for travel have been indicated.

The Mammoth Cave consists of a labyrinth of subterranean cells, united by winding apertures, corridors, and broad avenues, in which the traveler may wander an indefinite distance, without threading all its mazes. Indeed, as the carboniferous limestone is essentially cavernous, it is extremely probable that all its cells are connected with each other, and that subterranean journeys might be performed throughout the whole tract of country called the Barrens. Some apartments of this cave are small; others of a breadth and height eminently fitted to raise emotions of wonder and sublimity in the visitor, whose torch throws a dim light on rocky ceilings more than a hundred feet above his head. Stalactites, alabasters, and crystallized gypsums,



as white and variegated in form as flakes of snow, decorate the slowly-decaying walls of other apartments; while streams and pools of pure water are animated with fish, whose eyes, from the utter darkness of their habitation, have not been perceptibly developed. The atmosphere of this labyrinthine excavation, is said not to be damp to the feeling; but I have not met with any observations on its dew-point. Various processes of natural chemistry, perhaps, absorb the moisture of the air, and convert it into the water of crystallization. Besides the formation of crystalline carbonate and sulphate of lime, the nitrate of lime is constantly generated; out of which salt-petre was formerly manufactured, by the aid of wood-ashes.\* These caverns, at the time the rocks were deposited, were probably filled with soft or decomposable materials; which have since been dissolved or washed away; but the work of enlargement is doubtless still going on, by the slow conversion of their walls into nitrate of lime, a soluble salt.†

The temperature of the deeper parts of the cave, is said to be fifty-nine degrees Fahrenheit, throughout the year.‡ In winter, a current of air descends into the cave; in summer, escapes from it; often with such velocity as to extinguish the lamps of those who are entering. This is apparently the only mode in which the external atmosphere modifies that of the cavern. The air of the cave has not been analyzed. Its sensible qualities are simply those of freshness. No difficulty of respiration, or headache, is produced by the atmosphere of any apartment, and the lights which visitors carry burn brightly in every part. Hence, we see, there is no addition of carbonic acid gas, or other mephitic air. Dead animal matter does not become putrid, but undergoes desiccation. There are no reptiles of any kind. Neither light nor sounds make their way into the deep recesses. They who have visited this great excavation, speak of wandering and clambering for a whole day without fatigue. They regard the atmosphere as invigorating. It may be that it holds saline substances in solution, which, entering the blood by the lungs, favor its aeration, and thus ward off the fatigue of exertion; or the mental excitement may support the strength of body.

When salt-petre was manufactured there, it was observed that the health of the operatives was excellent, and that many 'ailing' or 'weakly' persons became sound in health, and experienced increase of flesh. The oxen, also, that were employed, not only continued in good health, but became fat. With these facts before their eyes, the people near the cave have long believed that it might be made an advantageous abode for invalids, especially those affected with pulmonary diseases, as they would escape all vicissitudes of temperature. It was not, however, until within the last few years, that cottages were erected, and sick persons publicly invited to make it a place of resi-

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\* Doctor S. Brown, in Transactions of American Philosophical Society.

† Western Journal, Louisville, October, 1847.

‡ Rambles in the Mammoth Cave, 1844.

doneo. This enterprise was undertaken by Doctor Croghan, of Louisville, who, having become its proprietor, was sanguine in the anticipation that it might be made signally beneficial to consumptive patients. Some experiments have been made, but the results, I believe, have not been encouraging. The mere seclusion of a patient from the changes of the weather, is not a positive influence, and by no means to be relied upon to arrest a malady which may occur independent of such vicissitudes. Then the solitude and silence, the darkness, the smoke, the atmospheric repose—for the wind is perceived only at the entrance—the want of exercise, the absence of many other exciters and sustainers of our mental and bodily activity, are counter-acting agencies, not to be forgotten in a candid estimate. To render a sojourn in these subterranean cells effective in the removal of diseases, the patients should have occupation, like those who once made salt-petre there; and to recommend such an abode to those who are too ill to labor, and are in need of medication, would seem injudicious, if not absurd. To what forms of chronic disease such a residence is, in fact, best adapted, cannot, I think, be determined *a priori*. I would conjecture, however, that chronic bronchitis, and functional disorders of the stomach, bowels, liver, and spleen, would be more certainly relieved than any others. To these I would, conjecturally, add subacute ophthalmia, obstinate ulcers, and other chronic affections of the skin. As to phthisis, if the patient could engage in hard labor, and the tubercular transformation of his lungs had not advanced very far, it might, perhaps, be arrested; but if he had reached the latter stages of the disease, he would do well to remain at home.

A more favorable opinion may be given of visits to the cave, than of a constant residence in it. As a place of resort for invalids who require exercise, with change of scene, it has much to recommend it; for its 'wonders are past finding out,' and, for several weeks, an inquisitive invalid might find exercise and interest in threading its labyrinths, while the weather was either too cold, or too hot, or too wet to admit of his taking adequate recreation in the open air. To all such it may be announced, that the munificent proprietor has taken care to provide comfortable, and even elegant accommodations, near the portals of the cave.

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## SECTION VI.

### THE LEFT BANK OF THE OHIO, FROM GREEN RIVER TO SALT RIVER: BASIN OF THE LATTER.

I. *THE RIVER.*—The length of this portion of the Ohio River is about one hundred and sixty miles. In ascending it, we cross the thirty-eighth parallel of latitude. The general character of the bed and banks of the river is the same that was set forth at large in Section II of this Chapter. At several points the river has cut through beds of coal; it also traverses the

underlying carboniferous limestone, which, in certain places, presents mural precipices, bearing red cedars. As we advance upward, the second bottoms become more elevated, and the lower alluvial lands are rather less subject to inundation. In Hancock county there is an expansion of the river-bottom to the width of seven miles.\*

There are several thriving villages on this bank of the river, of which Hawesville, where coal is dug, is the most noted. The whole, together with the country between them, are subject to intermittent and remittent fevers, but not to such a degree as to retard their growth or prosperity.

II. BASIN OF SALT RIVER. — The breadth of this little basin, unlike that of most through which we have traveled, is quite equal to its length. The river consists of two principal branches. The southern, bearing the name of Rolling Fork, interlocks to the south with the waters of Green River; the northern, known as Salt River, has its origin between the Kentucky River and the Ohio. Their union is but a few miles from the junction of the common trunk with the Ohio, twenty miles below Louisville. Salt River proper, or the northern branch, has all its head-waters in an out-crop of the upper Silurian limestone, which emerges not far above Louisville, and extends to the Kentucky River at Frankfort. This region presents ravines and low winding ridges, having a fertile soil, with tolerable springs and very few marshes. But, as in the other basins where the geology is the same, the streams sink in summer and autumn into pools, and the country is not exempt from fever. The Rolling or southern Fork has its origin mainly in the carboniferous limestone of the adjoining Green River Basin; and much of the surface which it drains is hilly; some parts low-mountainous. The immediate valleys or troughs of both forks of Salt River, present a considerable extent of bottom-land, which, with that along the common trunk, is occasionally inundated. Fevers, often malignant and fatal, prevail along these streams, especially low down, where their common valley opens into that of the Ohio.

III. HARRISONBURG SPRINGS. — These springs belong to the basin now under examination, being situated near the sources of Salt River. Unlike most of the mineral springs of Kentucky, which are found in deep valleys, these burst out near the summit-level of the country, at an altitude of near a thousand feet above the Gulf of Mexico. From near the springs, small tributaries of the Kentucky River and of Dick's River flow off to the east and north, and those of Salt River to the south and west; a sufficient evidence of the relative elevation of the spot where they are found. In every direction, for several miles round, the country is as free from drowned lands, marshes, swales, and ponds, as any other equal area in the Ohio Basin. In fact, there does not seem to be a single source of malaria in their neighborhood; and my colleague, Professor Miller, who practiced medicine nine years in this locality,



PL X

TOWN OF HARRODSBURG

June 1881

HARRODSBURG  
SPRINGS

Scale - 300 ft. to 1 inch

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EXPLANATIONS

1. Springs
2. Field
3. New Road
4. Old Road
5. Building near the
6. Bank House
7. Lighthouse
8. Building near the
9. Old Road
10. New Road
11. Lighthouse
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has assured me, that intermittent and remittent fevers are far less prevalent here than in the Barrons.

The town of Harrodsburg, in the suburbs of which we find the springs, was the first-settled spot in the state of Kentucky; and consequently the soil has been under cultivation since the month of June, 1774; that is, nearly seventy-five years; a period quite sufficient to diminish those elements on which autumnal fever remotely depends. I am the more careful to set forth these facts, because most of the watering-places in the West, from being in valleys, are scourged in August and September with bilious fevers; and because the invalids of the South-west, especially those who have been made such by its fevers, cannot have their constitutions repaired by sojourning at springs which are situated in malarious localities.

Harrodsburg Springs are not only in the oldest-settled spot in the valley of the Ohio, after Pittsburgh, but they issue from strata which, I am informed by Professor Yandell, rest upon the very oldest formations known in the Ohio Basin. Considered in reference to chemical character, they are magnesian limestone.

Desirous of publishing an accurate account of the composition of these waters, I desired Doctor G. H. Raymond, of Cincinnati, to visit and analyze them; which he did in the month of October, 1848, selecting the two fountains from which invalids are chiefly supplied. The following are the results with which he has furnished me:

#### THE GREENVILLE SPRING.

*Ingredients in a pint of the water, stated in grains and hundredths, Troy.*

Bicarbonate of magnesia, - - - - -	2.87
Bicarbonate of lime, - - - - -	0.80
Sulphate of magnesia (crystallized), - - - - -	10.10
Sulphate of lime (crystallized), - - - - -	11.06
Chloride of sodium, a trace.	<u>80.06</u>

#### THE SALOON, OR CHALYBEATE SPRING.

*Quantity of water the same.*

Bicarbonate of magnesia, - - - - -	0.48
Bicarbonate of lime, - - - - -	4.81
Bicarbonate of iron, - - - - -	0.50
Sulphate of magnesia (crystallized), - - - - -	27.02
Sulphate of lime (crystallized), - - - - -	10.24
Chloride of sodium, - - - - -	1.20
	<u>44.00</u>

The bicarbonate of iron in this spring is sufficient to impart to its salts a light fawn-color. The water of both springs is limpid. Doctor



Raymond could not detect either free carbonic acid or sulphureted hydrogen gas.\*

It will be seen by these analyses, that every tumbler of the water of the Greenville Spring contains within a fraction of sixteen grains of saline matter, more than half of which consists of magnesian salts; that every tumbler of the water of the Saloon Spring contains twenty-two grains of saline matter, two-thirds of which are sulphate, with a small quantity of bicarbonate, of magnesia; and that in the same quantity of the water there is a quarter of a grain of iron. The patient, who in one morning drinks four tumblers of the water of the Saloon Spring, takes nearly a drachm of sulphate of magnesia, with other saline ingredients, and a grain of bicarbonate of iron.

I shall follow these estimates no further, but proceed to say, that the water of the Greenville Spring is the better antacid — that of Saloon, the better tonic. Indeed, small as the quantity of iron is, it sometimes produces an uncomfortable feeling in the head, which is relieved by drinking at the other fountain. In reference to the excretions, the water from both acts upon the bowels, kidneys, and under proper regulations at night, upon the skin. Beyond these sensible effects, it pervades the whole constitution, and many classes of invalids very soon feel a renovation of appetite, strength, and cheerfulness, although its primary effects seem to be sedative, not stimulant. I transcribe from the article in the Journal already quoted, the following remarks on the curative effects of these waters:

"The cases to which they are, in a peculiar manner, adapted, are chronic inflammations, and obstructions in the abdominal viscera. Thus, they are

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\* In the year 1823, while attached to the medical department of Transylvania University, assisted by my ingenious and lamented friend, the late Doctor Robert West, adjunct to the Professor of Chemistry, I made a *qualitative* analysis of the water of the Saloon Spring; which has ever since been before the public. (See West. Jour. of Med. and Phys. Science, Cincinnati, June, 1828.) A want of faith in its accuracy, led me to propose a new analysis, by a much abler hand. The results then obtained were the following:

Carbonate of magnesia,	- - - - -	in a small quantity,
Carbonate of lime, -	- - - - -	" minute "
Sulphate of magnesia,	- - - - -	" large "
Sulphate of lime, -	- - - - -	" small "
Sulphate of soda,	- - - - -	" " "
Iron (probably in the state of a sulphate),	- - - - -	a trace
Sulphureted hydrogen,	- - - - -	in a minute "

It will be observed, that this analysis and that by Doctor Raymond give nearly the same ingredients; and both nearly correspond with one made subsequently to mine by Professor Yandell. (Transylv. Jour.) Doctor R. has more properly regarded the carbonates as bicarbonates, and ascertained that the iron is a salt of that kind, instead of a sulphate; he likewise found the soda to be combined with hydrochloric acid, instead of the sulphuric; finally, he could not detect any sulphureted hydrogen; which may, perhaps, sometimes be present in minute quantities, and sometimes absent. In his examination, subsequent to my own, Professor Yandell detected that gas in small quantities.

ominently serviceable in such cases of dyspepsia as are attended with subacute gastritis; in almost every kind of hepatic disorder, except when the liver is indurated, and, consequently, incurable; and in constipation, so constant an attendant on diseases of the stomach and liver. They are almost equally beneficial in chronic inflammations of many other parts of the system—especially of the serous and fibrous membranes. In tonic dropsies, in rheumatism, and in various affections of the pericostum from febrile metastases, from syphilis, and from mercury, they have often effected a cure, when other means had failed. In several urinary disorders they have done equal good. In chronic diseases of the skin they have also been found useful, when the patient has been subjected to a regimen that has determined them to the surface. In pulmonary complaints they have been found serviceable; but not in the same degree as in disorders of the abdominal organs; and their use in these maladies requires discrimination. In chronic pleurisy, and the early stages of subacute bronchitis, they have performed cures; but in vomica, tubercular suppurations, and hepaticization of the pulmonary tissue, they are injurious, and, if persevered in, may even prove fatal. When they have rendered occasional assistance in these affections, it was chiefly by correcting a morbid condition of the digestive functions, so often associated with them. In sick headache they occasionally do good; but many cases of that obstinate malady are attended with such an enervated condition of the nervous system, that their sedative operation becomes prejudicial."

The experience of multitudes, since these remarks were published, twenty years ago, has, in the main, confirmed their accuracy, and even added to the catalogue of maladies which have been palliated or removed.

The Harrodsburg waters have, by exportation, been extensively distributed over the South-west, and even found their way into use in several of our garrisons. The salts obtained by their evaporation have long been employed by the people, and also by many physicians, who have found them more efficacious than the officinal sulphate of magnesia.

It is proper to say something of what art has done to make this an acceptable residence to the infirm, and to the friends who may desire to accompany them. To this end, the enterprising and courteous proprietor, Doctor Christopher Graham, through a period of twenty-five years, has devoted himself, with a liberality only equalled by his taste and diligence. Within that period, his permanent expenditures have exceeded two hundred thousand dollars, and he is still inventing new means for comfort, amusement, and the beneficial use of the water; among which are baths, both cold and warm, the latter of which, from the high degree of saline impregnation, cannot but prove valuable in a great variety of cases.

A topographical map (*Pl. X*) of the grounds around the principal spring, including the various improvements, has been made at my request, by Captain Fuller, Topographical Engineer, the inspection of which will render a description of them unnecessary; and I need only say, that while the waters

are perhaps adapted to as great a variety of infirmities as any now in use in any country, the accommodations which have been created will, from the reports of travelers, bear an advantageous comparison with any to be found either in America or Europe. Such is the spot which, in the midst of a highly cultivated society, may be added to the wild scenes on the Tennessee River, the Mammoth Cave, the Upper Mississippi, and the Great Prairies, already recommended as places of beneficial resort for various classes of invalids.

But the attractions of the Harrodsburg locality are not confined to its medicinal waters and its munificent accommodations; for, although it lies in a region of fertile and gently rolling country, which would seem to promise nothing rare or romantic in nature, it is by no means destitute of objects and scenery which the eye of taste must regard with the deepest interest. About fifteen miles to the south-east are the 'Knobs,' where, on a plain, the basis of which is the black or Devonian slate, may be seen a scattered and picturesque group of slate-clay pyramids, or rude, truncated cones, rising from one to two hundred feet in height. At a less distance to the east, is the gorge through which Dick's River precipitates itself into the Kentucky. Lastly, at the distance of eight or ten miles to the north, the beholder finds himself on the verge of a chasm, as deep, and dark, and wild, as that of Niagara below the Falls. In this profound ravine, with walls of the oldest transition marble, and a garniture of mingled evergreen and deciduous forest trees, the Kentucky River quietly winds its way, and, by its very repose, seems to say that its work of excavation is finished.

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## SECTION VII.

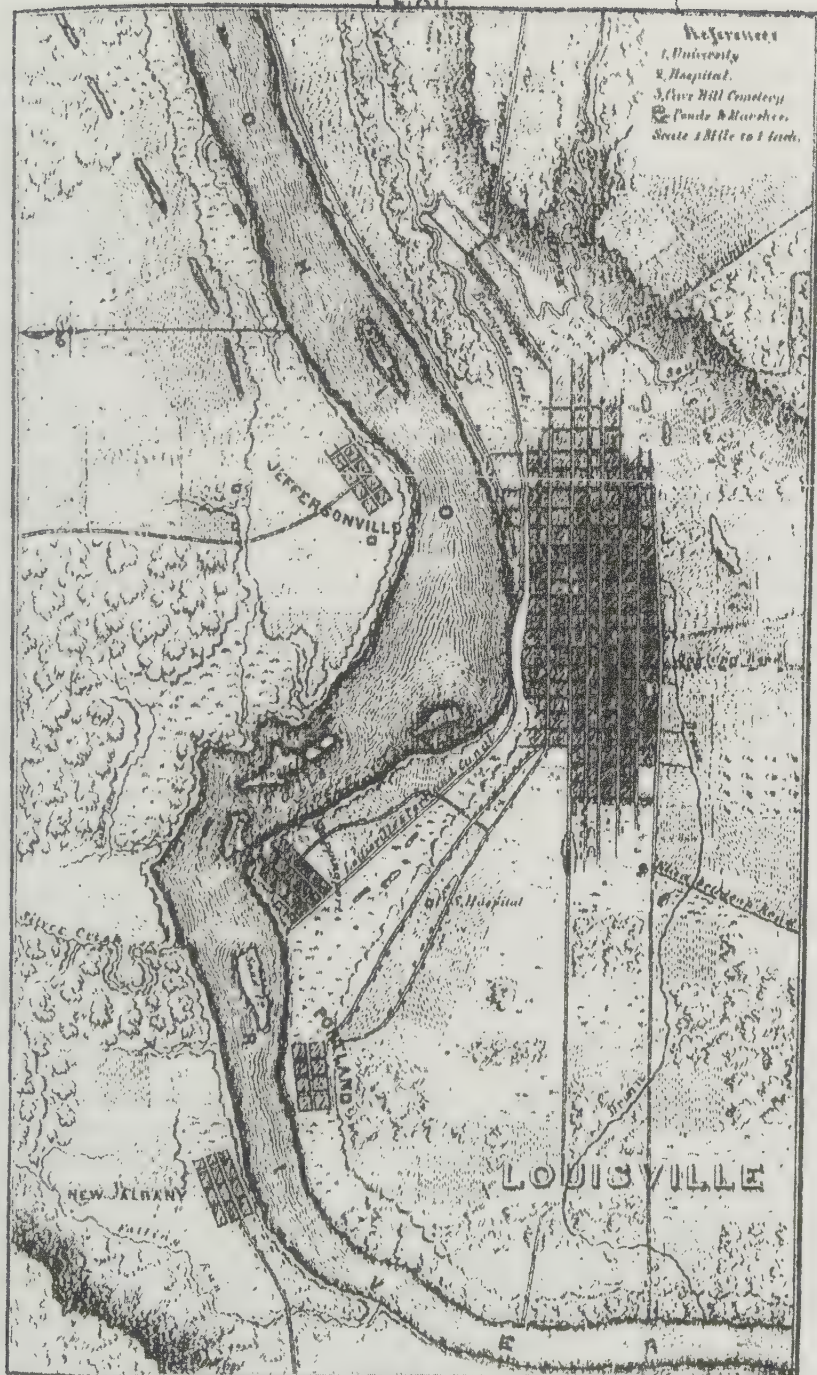
### FALLS OF OHIO—LOUISVILLE.

I. **TOPOGRAPHY.**—In ascending the Ohio River from the mouth of Salt River to the Falls, the course is but a few degrees east of north—the distance about twenty miles. In traveling from one point to the other by land, the journey is over a plain, the elevation of which is above high-water mark, and its breadth from three to five or six miles. From every part of this plain, which extends to the river on the west, the blue range of Silver Creek Hills may be seen, running parallel with the river on its western or right side, while a lower range, called the 'Knobs,' is seen to terminate the plain on the opposite or eastern side. Thus between Salt River and the Falls, there is an ample terrace, elevated nearly as high as the second bottoms of the river, already described in Section II of this Chapter. It cannot, however, in strictness, be classed with those deposits, which, generally sloping back toward the hills, and composed largely of gravel, pebbles, and bowlders, retain but little water on their surface; while this, although it presents many beds and ridges of sand or sandy loam, so abounds in clay, that the



## References

- 1. University
  - 2. Hospital
  - 3. Olive Hill Cemetery
  - 4. Parks & Marshes
- Scale 1 Mile to 1 Inch.





rains are but slowly absorbed, and, at the same time, it is so level as to prevent their readily flowing off. Thus, in times long gone by, they accumulated in the depressions on its surface, and overspread it with ponds and limited elm and maple swamps; which dry up in summer and autumn, but at other seasons send out small streams that make their way into Salt River, and into the Ohio, both above and below the Falls. The middle and southern portions of this plain, where the natural cisterns were, and still are, of greatest extent, is called by the ominous name of the 'Pond Settlement.' The area of the entire plateau cannot be less than sixty square miles; the whole of which lies to the summer-windward of the city of Louisville, which is built on its northern extremity, opposite to and above the Falls. The site of the city itself was swampy, with shallow ponds, and although more than seventy years have elapsed since the commencement of settlement, specimens of both may be seen within two miles to the south and west of the city quay; for the draining of which a trench has been dug, as may be seen in *Pl. XV.* Even the streets of the southern suburbs, show a soil retentive of moisture and disposed to swampiness, while the surface is so level as to render all draining difficult. To the south-east of the city, the creek called Beargrass descends from the higher lands, and being joined by streams which originate on the plain, flows to the north along the base of the low hills, until it reaches the river-bottom, when it turns to the west, and, like a narrow canal, makes its way for a mile nearly parallel to the river, which it finally joins at the middle of the northern margin of the city. The water in the estuary of this creek is generally foul and stagnant; and the slip of bottom between it and the river is sometimes overflowed. A quarter of a mile from the mouth of Beargrass, opposite the lower part of the city, is the head of the Louisville and Portland Canal, which, after running two miles, enters the Ohio below the Falls. The bed of the canal is in solid rocks, the removal of which has given it high and stony banks; but on each side, and especially between it and the river, after the first mile from its head, the bottom is so low as to be subject to annual inundation. On this bottom, immediately above the junction of the canal with the river, stands the old, declining village of Shippingport. Below the junction, on a bank so high that even its most depressed portions are inundated only by the greatest floods, is the newer and more growing town of Portland; in the rear of which, to the south, there are many small ponds and swamps, situated on the upper terrace.

II. GEOLOGY OF THE FALLS.—Reference has been already made to a range of hills on the western side of the Ohio. Their altitude is between five and six hundred feet above low-water mark. They constitute the final out-crop, to the east, of the fine-grained sandstone, with beds of limestone, which underlie the Illinois coal basin. At the base of these hills there is an out-crop of black or Devonian slate, and from beneath it the limestone of the Falls emerges. This limestone, as Doctor Shumard informs me, belongs



to the Devonian group, but is far harder and more indestructible than the slate which rests upon it. With these facts before us, the explanation of the production of the Falls is not difficult. Flowing over the limestone from the east, and reaching the softer slate, the water would excavate it more rapidly, and very soon a descent from one formation to the other would be established. The depth of this descent is probably still on the increase. The entire fall at this time is twenty-five feet nine inches. Above the rapids, the extreme rise of the river, from low to high-water, is forty feet two inches; below, sixty-four feet five inches.\* The general level of the great terrace on which the city stands is twenty-four feet above high-water mark, which being four hundred and seventeen feet above the sea, makes the elevation of the Louisville plateau four hundred and forty-one feet.

After the few words which have been said on the geology of the Falls, the explanation of the origin of the plateau which has been described, will be easily made. The spot it occupies was once covered by a deep bed of black slate, which has been washed away or decomposed, and left, in part, to constitute the present materials of the plain; and, like those left by all disintegrated slates, they abound in argillaceous matter, which prevents the rains from sinking into the earth, and thus swamps and ponds are generated.† Had an equal amount of sandstone been decomposed, a dry and sterile plain would now occupy the place of that which has been described. Thus it is that geology illustrates topography. In most parts of this plateau, excellent hard water is obtained by sinking wells.

III. THE CITY OF LOUISVILLE is in N. Lat.  $38^{\circ} 3'$ , and W. Lon.  $85^{\circ} 30'$ . Its position in reference to the river, the Falls, the estuary of Beargrass, and the pondy terrace to the south, may be seen in *Pl. XL*. In former times, a large portion of its dwelling-houses were built with basements above the ground, to avoid the dampness of the surface. The change in that fashion, which is going on, indicates the progressive drying of the soil. The houses are chiefly of brick. Several of the streets are unusually wide. No parts of the city are very compactly built. Its spread has been up and down the river, much more than from it, as the swales and ponds in its rear have limited its extension in that direction. The descent of the streets near the river is such as to admit of successful drainage; but, at the distance of a few squares from the bank, the levelness is so great as to interfere materially with the discharge of the contents of the gutters into the sewer which has been dug behind the town, the outlet of which is into the Ohio some distance below the Falls. The fuel of the city, formerly wood alone, is now chiefly coal. It has no hydrant system, and well-water is in universal use. Its manufacturing establishments are not sufficiently numerous and extensive to merit the attention of the etiologist, with the single exception

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\* Colonel Long, U. S. Topographical Engineer, MSS. *peneb me.*

† Contributions to the Geology of Ky. By Doctors Yandell and Shumard.

of hemp-carding and spinning. Louisville was originally settled by emigrants from Virginia, but at the present time its population includes people from most of the states, and also from various kingdoms of Europe, of whom the Germans are the most numerous.

IV. AUTUMNAL FEVERS.—From the earliest period of its settlement, the whole plateau, from the Falls to Salt River, has been infested with autumnal fevers, intermittent and remittent, simple and malignant. They still prevail, but wherever clearing, cultivation, and draining have extended, they have signally diminished. Some portions, however, have repelled those who, settling upon, might have transformed them, and still remain unreclaimed. Louisville itself offers a beautiful example of the influence of civil improvements, in destroying the topographical conditions on which these fevers depend. For a long time, when its population was small and scattered, its streets unpaved, and its out-lots overspread with small swamps and shallow ponds, the annual invasions of autumnal fever were severe; and in 1822, a sickly year over the West generally, it was scourged almost to desolation.\* With increasing density of population, however, and the consequent draining, cultivation, and drying, a great amelioration has taken place; and fever, especially the intermittent form, is now a rare occurrence in the heart of the city; but as we advance into the suburbs, the disease increases. Thus a difference of a few squares, gives a striking difference in autumnal health.†

To the east, the people on both sides of Beargrass are peculiarly subject to fever; and to the west, those of Shippingport, situated, as we have seen, in a low river-bottom, are equally liable.

## SECTION VIII.

### BASIN OF THE KENTUCKY RIVER.

I. ASPECT OF THE OHIO RIVER.—The distance from the Falls to the mouth of the Kentucky River, is sixty-two miles; the course, in a direct line, nearly north-east. The river-bottoms, on the left or Kentucky side, do not present any important town, or any remarkable locality. The hills at first are low, but rise gradually, and are composed of the Devonian limestone, which emerges at the Falls; to which succeed out-crops of upper Silurian, or gray cliff, and then lower Silurian, or blue shell limestone. Immediately above the junction of the Kentucky with the Ohio stands the old village of Port William, now called

II. CANNONTON.—The extensive bottom on which it is built, consists of a narrow terrace along both rivers, liable to spring inundations, and a higher and broader plateau, which in the rear is depressed, and was formerly a

\* J. P. Harrison, M. D., in the Phil. Jour.

† Contributions to the Geol. of Ky. By Doctors Yandell and Shumard.

swamp, covered with semi-aquatic shrubs and herbaceous plants. By ditching and destroying the natural vegetation, this tract of forty or fifty acres is now dry and reduced to cultivation. From Doctor Mason, my authority for this fact, I learn that formerly the people living adjacent to this swamp suffered greatly from fever, especially intermittents, which even overspread the village; but since the abatement of the paludal nuisance, the disease has almost disappeared, notwithstanding the shores of the two rivers remain nearly in the condition in which they were when the disease prevailed.

III. GENERAL CHARACTER OF THE KENTUCKY RIVER.—From the sources of this river in the Cumberland Mountains, to its mouth, the direct course is nearly north-west; but it does not flow on that line. For the first half of its length it runs nearly west; through the second half, almost north. In ascending it, for the first thirty or forty miles the bottoms are of such width as to admit of cultivation, and, in general, so elevated as not to be overflowed. These bottoms gradually narrowing, the opposite hills approach each other, and, before we reach Frankfort, the capital of the state, present a ravine with mural precipices; a conformation which continues for a great distance, and has been already pointed out in treating of the Harrodsburg Springs. Beyond this ravine, the upper parts of the river are found among the flanks of the Cumberland Mountains, in the Appalachian coal formation. The lower strata found in the walls of the ravine, belong, as I am assured by Doctors Yandell and Shumard, to the oldest limestone met with in the southern Interior Valley, as it underlies the blue Silurian limestone of Natchez and Cincinnati. Of course, except near its mouth, the alluvial grounds of such a river can present nothing of interest to the medical topographer; but the river itself deserves attention. The fall through its lower half is so inconsiderable, that the high floods of the Ohio River exert an influence as far up as Frankfort, seventy-five miles. From this approach to a horizontal bottom, the river formerly presented, in summer and autumn, a series of pools and ripples, from the margins of which exhalations arose which generated autumnal fevers. A few years since the state of Kentucky constructed a series of dams and locks, which have created a slack-water, navigated for the distance of nearly one hundred miles. Thus, the river, except when in flood, presents a series of long and deep pools, which do not sink so low in times of drought as the natural pools, and consequently there is less exposure of foul margins to the sun.

Anxious to ascertain the effect of this change in the condition of the river on autumnal health, I wrote to Doctor Drane, who resides in Newcastle, a few miles from its left bank, and his reply was that it had not increased the annual sickness. I also wrote to Doctor W. O. Sneed, of Frankfort, who answered the question as follows: "The slack-watering of the Kentucky River, has very materially improved the health of the people living along its banks. The old-fashioned fevers have almost entirely disappeared, and settlements that were once considered very unhealthy in



autumn, are nearly exempt from the epidemics under which they suffered. I have paid special attention to this subject for the last seven years, and feel fully satisfied that the facts above stated are correct." Doctor Mason, of Carrollton, however, has informed me, that the people who reside along the first pool formed by a dam, only two miles from the mouth of the river, have been more affected by autumnal fever than before the erection of the dam. These discrepancies are resolved by referring to the character of the banks of the river. Opposite the first pool they are broad; where the observations of Doctor Doane were made, they are much narrowed, and at and above Frankfort they are narrower still. Where the bottoms are widest the dams have done harm; where narrowest, good; where intermediate, they seem not to have produced any effect on health.

IV. FRANKFORT.—The bottoms of the Kentucky River are so narrow, that throughout its whole length there is not a town entitled to the slightest notice, except Frankfort. The fourth lock-dam is about a mile below it. The bottom on which the town stands is north-east of the river, elevated above high-water mark, and has an altitude above the Gulf of Mexico of about four hundred and eighty feet. Its area is very limited, and hills upward of three hundred feet high closely environ it to the west, north, and east. Between the northern and eastern hills a small stream, with swaley borders, makes its way, through a valley disproportionately wide, to the river. This valley, I was told, opens into the river below the town, and seems to have been once the bed of a part of the river. To the south, on the opposite side, but a little above, there is a tract of bottom-land as large as that on which the town is built. It is less elevated than the town-plot, and sometimes suffers inundation. This locality has always been subject to intermittent and remittent fevers, in which the people living in South Frankfort, and near the obsolete river-bed to the north-east of the town, have participated most deeply. The penitentiary of the state stands near the upper end of this outlet, and Mr. Joel Scott, who was its keeper for nine years, informed me that intermittents occurred among the convicts every autumn. According to Sneed, just quoted, the conversion of the river opposite and above the town into a deep and permanent pool, has diminished the frequency of fevers.

Frankfort is an old-settled town. Its Lat. is  $80^{\circ} 14' N$ . The inhabitants are supplied with hard water.

V. UPLAND PORTION OF THE KENTUCKY RIVER BASIN.—Every part of this basin is uneven, ridgy or hilly, rising in the east into mountains. Swamps are almost unknown; but it has some small natural ponds, and latterly, a much greater number formed artificially, not for irrigation, but for stock-water. This suggests that the tributary streams of the Kentucky River generally are apt to fail, which is the fact. In dry summers and autumns, the beds of many even become dusty, while all are reduced to the condition of pools, united by thready currents. As most of them have rocky beds and limited alluvial bottoms, this drying-up is not accompanied by the pro-

duction, to any great extent, of autumnal fever; and no region over which we have traveled, east of the Mississippi, is, on the whole, more exempt. It is a fact, however, that even those ridges which are separated by the most transient brooks, and where scarcely any surface-water can be seen after the summer solstice, *remittent* fever is not uncommon; while in the neighborhood of the larger streams there are superadded mild intermittents; the latter, however, are the more frequent of the two. This basin comprises the oldest settlements anywhere on the tributaries of the Ohio, except those of Western Pennsylvania, as they date back to the year 1774; and consequently its forests are extensively destroyed or thinned out; and most of its surface was long since transformed from a wild to a cultivated state. Through all these conditions, consequent on its settlement, it seems to have been but lightly affected with autumnal fever, except on the banks of the larger streams. The special topography of a few localities will further illustrate the whole.

VI. DANVILLE.—This town, one of the oldest of the state, is situated only ten miles south-east from Harrodsburg, and two miles from Dick's River, a tributary of the Kentucky. As the seat of a college and of the State Deaf and Dumb Asylum, it has claims to a passing notice of its topography and autumnal health. The site is a flatted ridge, passing into a surface still leveler, especially to the south-east. There are some small ponds, both natural and artificial, in its neighborhood, but no marshes. Its rivulets and streams, like those in other parts of the basin, become sluggish or dry up in summer and early autumn. Like the neighboring town of Harrodsburg, already described, it is very slightly affected, by autumnal remittent fever. Danville, just described, stands not far from the most southern portion of the great bend of the Kentucky River, mentioned in the general description. We must now cross the river to the north, and say something of the tract of country found within the bend.

VII. COUNTIES IN OR NEAR THE GREAT BEND OF THE KENTUCKY RIVER.—The counties of this locality, are Clark, Jessamine, Fayette, Scott, and Woodford, which have ever been, and still are, regarded as the garden-spot of Kentucky. They are among the oldest-settled portions of the state, and their surface is nearly all inclosed. The natural herbage, cane-brakes, and shrubbery are destroyed; but many open forests have been preserved, and a turf of blue-grass flourishes beneath their shade. The sub-stratum of the whole is Silurian limestone, on which rests a deep stratum of loam and mold. Marshes are almost unknown, but artificial ponds are numerous. The streams, in summer, become stagnant, and many dry up. In Fayette, the central and most important county, much of the surface originally presented deep and almost level deposits of black soil, abounding in moisture, and overshadowed by dense cane-brakes. The organic matters contained in these beds, have long since, by cultivation, been thoroughly exposed to the action of the air, rains, and sun. This tract, so noted for its fertility, is drained by the Elk-horn, a tributary of Kentucky River; and has been made the subject of a

paper in the Transactions of the American Philosophical Society, by the late distinguished Abbé Correa, Portuguese Minister to the United States, who was of opinion, that there had once been upon it a great deposit of vegetable matter, the decay of which had generated the deep stratum of mold. The chief prevalence of intermittent fever within the district we are now exploring, is along the trunk and branches of the Elkhorn, where it is not connected with alluvial ground, but with the reduced volume and slackened current of the water.

VIII. LEXINGTON.—The city of Lexington stands in Lat.  $38^{\circ} 2' N.$ , and Lon.  $84^{\circ} 26' W.$  Its elevation above the sea is eight hundred feet. One of the upper branches of Elkhorn Creek passes through it, the gentle slopes towards which, cause a perfect drainage of the site; but the stream as it flows off to the west, sinks into pools, in summer and autumn, and thus creates a limited source of insalubrity, to the windward of the city. Moreover, in different directions round the city, the surface, although decidedly undulating, does not favor a rapid escape of the rain-water, and many of the brooks have a sluggish current with spongy borders. Nevertheless, intermittent fevers are almost unknown, and remittents by no means common. Lexington is gradually becoming a summer-residence for southern families, for which its topographical condition gives it a decided fitness. A southern physician told me that, while a student, he spent eighteen months in that city, during which, without the use of medicine, an enlargement of the spleen—the result of intermittent fever—under which he had suffered for a considerable time, was entirely removed.

Lexington was once the metropolis, not only of Kentucky, but of the West. The first Lunatic Asylum and the first University in the Valley of the Mississippi, were established there. The medical department of the latter was organized in the autumn of 1817, and then began those medical teachings in the Interior Valley, which are now conducted by so many persons at such distant points. Its *alumni* have become the founders of schools, the editors of journals, and, largely, contributors to the work in which this testimony to a pioneer institution is recorded.

IX. South of the Cumberland River, the prevailing agriculture is that of cotton; north of that river, to the Kentucky River, of tobacco; north of the Kentucky, of hemp. Wheat runs through the whole, as maize runs through every region from the Gulf of Mexico up to that we are now studying. South-east of Lexington, at the distance of forty or fifty miles, begin the slopes of the Alleghany Mountains, and the Silurian limestone disappears beneath the shales and sandstones of the Appalachian coal formation. Of the prevalence of autumnal fever in that portion of the Kentucky River Basin, I am not informed. North of Lexington for about twenty miles, the topography remains nearly unchanged; then the surface becomes deeply cut, and of course rugged. The Silurian limestone is covered with clay bearing a thin layer of soil. Surface-water is scarce. The



principal stream, Eagle Creek, a tributary of the Kentucky, sinks low and becomes pondy. On the ridges, except near the stream, intermittents are almost unknown, but remittents occur more or less every year. Over this kind of surface we reach the Ohio, between the mouth of the Kentucky River, and that of Licking eighty-five miles higher up, and nearly half a degree farther north. Between the two there is no locality that merits special notice.

## SECTION IX.

### BASIN OF LICKING RIVER: NORTH-EAST KENTUCKY.

I. Licking River may be compared with Green and the Kentucky, to which it is parallel in course, and approaches in size and the area of its basin. Its sources are among the outliers of the Cumberland Mountain, immediately north of those of the Kentucky River; its junction with the Ohio is opposite Cincinnati. Its southern tributaries interlock with those of the Kentucky River, its northern with the brooks and rivulets which flow into the Ohio. Commencing in the Appalachian coal formation, it pours its waters into the Ohio, over the lower Silurian, or blue shell limestone of Cincinnati. I may add, that it flows a greater distance through that formation than any other affluent of the Ohio River. Almost everywhere it winds tortuously through a ravine, embracing narrow alluvial grounds, or none at all, until it approaches the Ohio, where, like those of the other tributaries, they widen. Its bed and banks are generally composed of rock. Its current is unequal, and in summer and autumn it presents alternate pools and ripples. Thus, in some places where it winds and labors among the hills, the surface of stagnant water becomes quite as great as if the country were flat and pondy. In the spring of the year, its freshets often overflow its banks. Nearly all its tributaries conform so exactly to its model, that a separate description is unnecessary.

The surface of this basin, as far up as the eastern out-crop of the Silurian limestone (which is nearly as far as we find much population), is rolling and rather arid, but has scattered mill-ponds, and is beginning to abound in artificial ponds, on which the agricultural population rely for stock-water, as permanent springs are scarce, and wells not only difficult to be dug through the hard Silurian strata, but often unproductive of much water. More than half of this basin has but a thin covering of mold, resting on a firm stratum of yellow clay, containing very little sand; but the remainder is as fertile as any portion of the Ohio Basin. The predominant trees of the former variety of soil, are oak; the latter is, or rather was, clothed in trees and shrubs which flourish on the richest soils of the middle latitudes, overshadowing the most northern cane-brakes found in the Great Interior Valley. Among the forest trees I may designate two as abounding, and which

are almost as characteristic of a locality but little infested with autumnal fever, as the cypress and liquidambar are indicative of the opposite condition,—they are the blue ash (*Fraxinus quadrangulata*) and prickly-shelled buckeye (*Asculus Ohioensis*).

Some portions of this basin, as the counties of Mason, Nicholas, and Bourbon, which constitute its center from north to south, are among the oldest-settled and most populous parts of the state of Kentucky, but the infertile soils are still but thinly peopled.

Of autumnal fever it may be stated, that the intermittent variety is limited to the neighborhood of the water-courses, where it appears annually in a simple and mitigated form. The remittent variety occurs in the same localities, and also on the driest ridges, between which there are no stagnant waters. Its character is commonly simple or inflammatory, tending to a continued or typhous type. But I may express this fact in a more specific manner. It is instructive to travel along the valley of the *Licking*, and its tributaries—*Stonor*, *Hinkson*, *Johnson's Fork*, and the *North Fork*—and find intermittents every autumn, while the intervening tracts of low-ridgy and arid surface between them, remain exempt, but are liable to remittents. In the once flourishing, but now decayed town of *Washington*, Doctor *Bayless*, a native of the place, informs me intermittents are absolutely unknown; but remittents occur more or less every autumn. There is so little surface-water, that the inhabitants have sometimes been compelled to haul water from the *Ohio*, at *Maynville*, a distance of four miles.

To the catalogue of anomalies presented by our autumnal fever, I may add two, which, it is true, are multiples of known irregularities, rather than novelties.

1. In the year 1795, a family settled in the woods, one mile out of the village of *Mayasick*, in *Mason county*, on dry blue-ash ridges, remote from all stagnant water, and remained entirely exempt from autumnal fever until the fall of 1800, when three children were seized, about the same time, with simple tertian intermittents, which proved obstinate, but not violent. The neighbors around remained unaffected, and the disease did not again occur in the family.

2. The village just named was situated under nearly the same topographical circumstances. It was settled in the year 1788, and its inhabitants remained free from autumnal fever, with the exception of sporadic cases, until the autumn of 1800, when an endemic remittent, manifesting a typhous tendency, arose and prevailed for two months, affecting part of the inhabitants of almost every house in the village, with many in its vicinity.\* By a careful examination, I ascertained that the topographical circumstances of the village were the same that year that they had been before, except what resulted from a great drought; the very condition which is said to preserve dry localities from autumnal fever, and promote it in the wet.

II. THE BLUE LOOPS.—This singular locality deserves a passing notice.

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\* Drake, in *Barton's Med. and Phys. Jour.*, Vol. III, p. 85.

Its center, twenty-four miles south from the Ohio at Maysville, is traversed by Licking River, on the banks of which are the Salines, vulgarly called 'Licks,' from the practice which the herbivorous animals of the forest had of licking the saline earth around such springs. The brine of these fountains is so dilute, that salt is no longer manufactured from it.\*

The characteristic of this locality is the absence of the stratum of soil and loam from the Silurian limestone, and a great deficiency of forest trees. The surface presents little else than dark moss-covered rocks. In latter years, however, groves of red cedar are beginning to overspread and increase its wildness. At what time and from what cause this tract lost its earthy covering, and became denuded of trees, or whether they had always been kept from growing there, cannot be told. Many years ago, the late Colonel James Morrison, of Lexington, informed me, that he first visited this spot in 1775, at which time the buffalo or bison (*Bos Americanus*) frequented it in such numbers, that they had formed roads to it from various parts of the country. They were accustomed to remain in the vicinity of the springs (drinking the salt water) for many days, on each visit, and to their depredations and trappings, with the action of the rains, he ascribed the formation of this desert in the midst of a fertile country. The discovery of the bones of the mastodon, and other gigantic extinct herbivorous animals, near the springs, shows that they, also, had frequented this locality. The Blue Licks are now resorted to as a watering-place. Muricate of soda, with abundance of sulphureted hydrogen gas, is the predominant ingredient of the water; which is shipped in barrels, and extensively consumed over the West and South.

In former times, when salt was manufactured here by furnace-heat, autumnal fever seems to have prevailed but little. Latterly, however, the sluggish river which winds round the springs, generates intermittents, which, nevertheless do not become prevalent until the latter part of summer, when watering-places are not much frequented. As some etiologists have fixed upon sulphuretted hydrogen as the efficient cause of autumnal fever, it may be asked, whether the intermittents of this locality should not be referred to that gas. The answer is, that the river is also present, and that the disease occurs with still greater violence in other places along that stream, where no sulphureted hydrogen is disengaged.

In concluding this account of the Licking Basin, I may remark that, in ascending towards the sources of the river, to the margin of the coal basin, the country becomes so barren and broken, that its population is sparse, and that but little is known to me of its autumnal health. That little indicates it to be good.

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\* The medical historian may perhaps be pardoned, for turning aside from his legitimate path, to say that, it was while attempting to make a little salt for his venison, at this place, in the year 1778, that the renowned Ohio Valley pioneer, Daniel Boone, was captured by the Indians; and that within this locality, in 1782, they fought a bloody and victorious battle with the first settlers of Kentucky.



III. **BANKS OF THE OHIO NORTH OF THE LICKING BASIN.**—For nearly a hundred miles the Licking basin extends almost to the hills, from which you may look down upon the Ohio River. Let us descend upon the banks of that river. On either side of the mouth of Licking, are the towns of Newport and Covington (*Pl. XIII*), which, however, belong to the Cincinnati locality, and can be best noticed in connection with that city. In ascending the river from this point, its left or southern bank presents the usual succession of bottoms, alternating with those of the opposite side, and mostly elevated above ordinary river freshets.

AUGUSTA, an old village, and the seat of a college, stands on one of these high bottoms, with hills in its rear; and is but little infested with autumnal fever. The next locality above which merits a description is that of—

MAYSVILLE.—This ancient landing-place of most of the immigrants to the state of Kentucky, has a historical importance that entitles it to attention; a claim which is strengthened by its being the most considerable town of North-east Kentucky. Its site is a narrow but high bottom, the surface of which is never reached by ordinary floods of the river; a small stream enters the Ohio at the upper end of the town, beyond which is a wider and lower bottom; but both lie to the leeward of the town. The bold and closely adjacent hills are composed of old Silurian limestone. On the opposite side of the river, there is a bottom of considerable width, which is sometimes overflowed. The autumnal fevers of Maysville and its vicinity are of a mild character.

The Ohio River above this town continues to present nearly the same banks and hills as below, until we ascend about twenty-five or thirty miles, when the latter become more lofty, and show by their outlines and aspect a change of geological character. We here leave the Silurian limestone (which dipping south-eastwardly sinks beneath the surface), and enter the Devonian sandstone and slate which underlie the Appalachian coal formation; and henceforth, as long as our exploration of the south side of the Ohio Basin continues, we shall travel over carboniferous and sub-carboniferous formations, with aspects of surface so different from most of those on which we have been looking, as to constitute it a new region. Before entering it, however, we must recur to some general views of the one we are about to quit.

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## SECTION X.

### GENERAL REMARKS AND CONCLUSIONS.

Having completed a survey of the fertile and populous part of the basin of the Ohio south of that river, it will be proper, before leaving it for another part of the basin presenting very different characters, to recapitulate some of its topographical and geological features.

I. Its southern and western boundaries are the sources of the streams which enter the Tennessee River through its left bank; the Ohio River constitutes its northern and a part of its western boundary; while to the

east it is bounded by the great out-crop of shale and sandstone which has a line of bearing from the Ohio River, above Maysville, to the Tennessee River, near Huntsville, the course being nearly south south-west. Immediately east of this high and abrupt margin, we come to the western side of the Appalachian coal formation.

II. Much of the largest limestone region of the Interior Valley of North America lies west of this out-crop, in Kentucky, Tennessee, and Alabama.

III. The creeks and rivers more generally flow in narrow ravines than those of any other portion of the Great Valley, and have more limited alluvial bottoms.

IV. While, as intimated in the first section of this chapter, the surface of that portion of the Ohio Basin which lies north of the river, is extensively buried up with *drift* or transported materials (much of it brought from a great distance in the north), the region we have been exploring has none; the trough of the Ohio River being its southern boundary.

V. The deposits of organic matter in all parts of the region we have explored, are comparatively limited in depth and area.

VI. Swamps, marshes, and sloughs are almost unknown; but ponds and pools, both natural and artificial, are common in every part.

VII. Copious and permanent springs are scarce; and the greater part of the countless number of brooks which irrigate the country in spring, dry up between the summer solstice and the autumnal equinox, or subside into stagnation.

VIII. When we compare this great region of transition and secondary rocks, with the cretaceous and tertiary regions lying between it and the Gulf of Mexico, we find instructive evidence of the influence which the geological constitution of a country exerts on its medial topography and hydrography: each of the two regions having a characteristic surface of deep interest to the physician, which is clearly referable to its geology.

IX. In the region we have explored, it was found that, as we advanced from south to north, there was a diminution in the prevalence of intermittent fever, which, at the same time, became more simple; there was also, but in a less degree, a diminished prevalence of remittent fever, and a gradually increasing tendency to assume a continued type. Although change of climate is a manifest cause of this modification, it is not, I presume, the only one; for we must, also, admit a telluric influence.

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## SECTION XI.

### THE OHIO RIVER, FROM MAYSVILLE TO BIG SANDY RIVER.

As intimated in the last two sections, when we ascend the Ohio to the distance of twenty-five or thirty miles above Maysville, the hills which from near Louisville are composed entirely of Silurian limestone, gray and blue, begin to show caps or summits of Devonian slate and sandstone, and at length are composed of those formations down to the water's edge. As we continue

to advance, a conglomerate or pudding-stone takes their place on the high hill-tops, and soon replaces them to the depths of the valleys. These changes result from an eastern or south-eastern dip of all these formations, beginning in the region between Cincinnati and Maysville, while west of that line the dip is in the opposite direction. Beyond the out-crop of conglomerate (which shoots up into lofty pinnacles) come the great deposits of iron ore, the salt wells, and the coal measures of the Appalachian formation, which we first met in North Alabama and East Tennessee. From this signal change of geological structure there results a topographical change, which is obvious to the eye of the ascending voyager; but the country on each side displays it, even more than the trough or immediate valley of the river. This continues substantially the same as it was from Louisville to Maysville; but both the river and its valley are perceptibly diminished in width, and, on the whole, the bottom-lands are less subject to inundation, except at the junction of some of the principal tributaries.

South of this section of the Ohio, the country is rugged; has an elevation of three or four hundred feet over the limestone country farther west; and is little fitted for cultivation, and but thinly peopled; characteristics which it preserves through to the Tennessee. I know but little of its autumnal diseases, which are undoubtedly of a mild character, compared with those along the lower portions of the rivers which originate in this sub-alpine belt.

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## SECTION XII.

### BASINS OF THE BIG SANDY AND GUYANDOTTE RIVERS.

The mouths of these rivers are but ten miles apart, and in their general course they run nearly parallel, with interlocking tributaries. The former, which is the larger of the two, makes a part of the dividing line between Kentucky and Virginia. Its junction with the Ohio is about ninety miles above Maysville. The natural historian of the coal region (which includes these rivers) is the able and indefatigable Doctor Hildroth, of Marietta, Ohio,\* who from personal observation gives us the following description:

"The space occupied by the tributary branches of these two streams, covers an area of about one hundred and twenty miles of latitude, and one hundred miles of longitude. Their head-waters rise a little north of the thirty-seventh degree, and interlock with those of the Clinch and Holston Rivers, and some of the western tributaries of the New River or Kanawha. Their extreme branches descend from the most elevated peaks of the Cumberland group of mountains, and from the flat mountains or table-lands found between the heads of the Holston and the Guyandotte. In their descent from this elevated region, they pass through some of the most wild, broken, and picturesque country to be found in the west. Immense deposits of sandstone rocks, piled up in enormous masses to the height of fifteen hundred or two



thousand feet, compose all the center part of this region. The streams are confined to narrow ravines and valleys, so deep as hardly to admit the rays of the sun at noon-day. Except near the borders of the larger streams, this whole district is a perfect wilderness. The scanty population which is widely scattered over its surface, obtain their support by hunting and digging the roots of the ginseng, an article as highly prized by the Chinese, as their more delicate teas are by us. This beautiful plant grows with great luxuriance and in the most wonderful abundance, along the rich virgin soil of the hill and mountain sides, composed of the disintegrated sandstone and the decayed leaves of the forest, which have been accumulating, undisturbed, for ages. For thirty years these hills and forests have furnished a constant supply of thousands of tons of this plant to the traders stationed at remote points along the larger streams. \* \* \* The hills and mountains, although steep and broken, are covered by an immense growth of forest trees, of all the species common to the climate, which here attain an elevation and a magnitude not seen in any other place; rich mountain sides in a temperate climate always affording a heavier and taller growth than the lowlands. \* \* \* It is but a few years since the bottom-lands on the Sandy were clothed with cane; and as late as the year 1805, boats visited that stream as high up as they could navigate, until checked by the falls, for the purpose of collecting the stems of this gigantic grass to be manufactured into reeds, &c. Since the ingress of domestic animals, the cane has wholly disappeared, except in some inaccessible recesses."

As Doctor Hildreth has said nothing of the autumnal fevers of this alpine region, which extends through Eastern Kentucky and Western Virginia to the upper valley of Tennessee River, I wrote to a gentleman of Ohio, Mr. George A. Warder, who had traveled up and down the valley of the Big Sandy; and although his answer is not full on that point, I will give an extract from it, as further illustrating the medical topography of a region but little known, although nearly surrounded by old settlements:

"I have passed up and down the Big Sandy River several times, and at various seasons of the year. The main river is about one hundred and fifty miles in length, rising in the mountains of South-western Virginia, and flowing a northerly course to the Ohio. The alluvial lands on the head streams are very narrow, and would not be considered worthy of cultivation in Ohio, but as the mountains are sterile, these small bottoms are occupied. As you descend, the valley widens to about a mile; from within sixty miles of its mouth the farms increase in size, and have a rich, warm, sandy soil. From the junction of the Louisa Fork with Tug Fork, twenty-five miles above the mouth, there is so little fall, that every considerable rise in the Ohio River affects this stream; and as there are a number of creeks emptying into it, every time a rise in the Ohio occurs, the back-water fills the outlets of these streams. The Sandy River is subject to very great and sudden rises; and I have been told that it has risen in one night sixty feet above its usual level, of course overflowing the bottom-lands and doing much damage. This can easily be accounted for, as the river is short, rises

in the mountains, and has a great deal of fall from its sources to the main trunk, which has very little. I do not remember ever having seen ponds of stagnant water anywhere along the valley. The upper part of this valley is very healthy; and I never saw or heard of ague and fever there;—but as we descend the stream, we might suppose its borders liable to that disease, yet I did not witness it. The water is beautifully clear, and is generally used by the inhabitants for drinking and household purposes, as there are but few springs. I believe there is no limestone from the source to the mouth of the stream, its course being entirely through sandstone."

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### SECTION XIII.

#### BASIN OF THE KENAWHA RIVER.

I. GENERAL DESCRIPTION.—This alpine river, one of the greatest tributaries of the Ohio, has its origin, by many large streams, among the summits of the Appalachian Mountains of Virginia and North Carolina, at an elevation of from two to three thousand feet above the level of the sea. The principal and longest stream, called New River, begins in the granite escarpment of the Blue Mountains, within the latter state, and takes a course nearly north. The Greenbrier, which belongs to the former state, first joins it, and then succeeds the Gauley, when the common trunk assumes the name of Kenawha. Between the mouths of Greenbrier and Gauley Rivers, the distance is seventy miles, in passing through which New River descends more than seven hundred feet. Soon after their being joined by the Gauley, the united waters are precipitated twenty-two feet, from a ledge of sandstone. These are the 'Great Falls,' whence the river flows with a gentler current to the Ohio, at Point Pleasant, seventy miles below. From its utmost source in North Carolina, this river, pursuing a north-west course, has boldly cut its way through several mountain chains, and thus develops some of the wildest and sublimest scenery within our Great Valley. On this, however, we must not dwell, but proceed to direct our attention to such localities as are of interest to the medical topographer.

II. VALLEY OF THE GREENBRIER.—This, in the opinion of Doctor Hildreth, was once the basin of a lake. To the east and west it is bounded by the mountain ranges denominated Alleghany and Greenbrier, which are thirty-five or forty miles apart in the south, where New River, cutting through both ranges, traverses the valley nearly at right angles to them, and on its way from one to the other, receives Greenbrier River. To the north-east, at the distance of one hundred miles, these mountains, by gradual approximation, coalesce, and there Greenbrier River has its beginnings. These sources are two thousand feet above the level of the sea, and the junction of the stream with New River is at the altitude of thirteen hundred and twenty-five feet. Thus, the average elevation of the basin may be taken at sixteen hundred feet, while the mountains which bound it are as much more. Over its whole surface there is a thick calcareous deposit, resting on

sandstone, with sinking springs, and caves containing salt-petre earth. The soil of the valley is calcareous, and abounds in decomposed vegetable matter. Its surface is hilly, with some spots called 'levels.' The celebrated White, Blue, Red, and Salt Sulphur Springs of Virginia lie in this valley.

III. VALLEY OF THE GAULEY. — "This stream is about one hundred miles in length, and, at its mouth, more than one hundred yards in breadth. It takes its rise in the spurs and sides of the Laurel, Greenbrier, and Gauley ranges of mountains. The country through which it passes is mountainous, and broken into lofty precipitous hills of sandstone rock. 'The cliffs of Gauley' are second only in height and grandeur to those of New River; extending for many miles on each side of the stream, at an elevation of five or six hundred feet. The river itself is precipitated over falls and rapids for a considerable part of the course; and its bed is so filled with huge blocks of sandstone rock, as to prevent any navigation on its waters."

IV. GLADES. — "Toward the heads of this river, the mountains spread out into table-lands, known by the name of 'glades.' They lie in long narrow patches, at an elevation of seven or eight hundred feet above the water-courses, with an elevated ridge or border along their sides, through which, at intervals, are found gaps for the water to pass off, down immense precipices, to the streams below. They are destitute of heavy timber. The more elevated and dryer portions produce fine crops of barley, oats, and potatoes, while the more wet afford good meadows, and the swampy places produce cranberries in abundance. The soil is black, based on yellow clay; indicating that these were, at some remote period, the beds of lakes or ponds."

V. AUTUMNAL FEVERS. — As the valleys of New River and the Greenbrier, with the table-lands or glades of the Gauley, have an elevation of from sixteen hundred to two thousand feet above the ocean, with moist soils, abounding in organic matter, and are comprehended between the parallels of thirty-seven and thirty-nine degrees of north latitude, they afford appropriate localities for ascertaining the influence of elevation on autumnal fever in those latitudes. Unable to visit them, I have sought, by correspondence, to obtain the desired information; but of twelve letters written to physicians in that region, two only have been answered. Doctor W. L. Bondurant, of Pocahontas county, high up Greenbrier River, in north latitude thirty-eight degrees fifteen minutes, writes as follows: "The surface of our soil is fertile, especially that of the Greenbrier bottoms, which are low and annually overflowed. On or near these bottoms there are scattering cases of intermittent fever every year; but remittent is much commoner, and often assumes a congestive type, terminating fatally in four or five days." From Doctor David M. French, of Giles county, far up New River, in about north latitude thirty-seven degrees fifteen minutes, I have received the following: "The valley of New River is at an elevation of from two to three thousand feet above tide-water. The general aspect of the country is mountainous. The soil of the parts which are sufficiently level for cultivation, is rich, productive, and peculiarly adapted to the growth of grass. Our climate is dry, but subject to great variations. Remittent fever is almost unknown among us; and



intermittents are rare occurrences. They happen only in wet seasons, and are always mild." By Professor Rogers, of the University of Virginia, whose geological survey of that state carried him in the region now under consideration, I have been favored with the following facts: "Along New River, from the mouth of Gauley up to the Blue Ridge, I have noticed cases of autumnal remittent and intermittent fever. These I have observed more commonly in the open districts, as in Monroe and Giles counties, than where the river traverses the mountains; but in no part of this region do they prevail as generally as in the Kenawha valley below. The extent of river-terrace or bottom-land is not so considerable in this upper valley of the river; but where such deposits occur they are covered with a productive soil, well charged with organic matter. The same remarks, as to health and soil, apply perhaps more strongly to the Clinch, and other streams flowing into the Tennessee River."

It would appear, from these observations, that an elevation of eighteen hundred or two thousand feet, in the latitude of thirty-seven or thirty-eight degrees north, is not sufficient entirely to prevent autumnal fever in localities which contain fertile soil abounding in organic matter.

VI. LOWER VALLEY OF THE KENAWHA.—From the Great Falls to its mouth, the Kenawha gradually widens, and its valley expands from half a mile to nearly a mile. The hills which bound it have, in the upper part, rather a sharp outline, with an elevation of seven or eight hundred feet; but they gradually sink to two hundred and fifty, and at the same time become more gentle. Two lateral valleys, through which Coal and Elk Rivers flow into the Kenawha, have the same topographical character with the principal valley. Its bottoms, composed of the *debris* of the coal formation, are, on the main, above high-water mark and well cultivated. Near the Ohio, however, they are more depressed, and as Doctor Couch and Doctor Shaw, of Point Pleasant, at the mouth of the river, informed me, are subject to inundations which leave, on receding, ponds and sloughs, abounding in decomposable matter. In descending the river early in July, I observed, that when reduced in volume, it becomes a line of pools and rapids.

The people who live near the mouth of the Kenawha suffer more from autumnal fever than those who inhabit the neighboring bottoms of the Ohio. Their elevation above the sea is about six hundred feet, or one-third as much as the altitude of the mountain localities which have been described. Their latitude is a little less than thirty-nine degrees north. Above the estuary of the river, up to the Great Falls, the fever is scarcely ever epidemic, and malignant cases are almost unknown.

VII. THE SALINES.—These extend ten or twelve miles up the valley, beginning at Charleston, about fifty miles from the Ohio. The width of the valley may be about half a mile; its course nearly north and south. The ranges of hills which bound it on either side rise from five to seven hundred feet above the bed of the river; and are composed of the sandstones, shales, and coal-beds of the carboniferous formation. The river-terraces are in general so high as not to be submerged, except in extraordinary floods. The

number of fountains is great, and they have been created by deep Artesian borings, from some of which there is a copious escape of hydrogen gas. As the brine is not evaporated by solar, but culinary heat, a vast number of furnaces, supported by bituminous coal, are night and day in blast. Some of them, however, are maintained by the combustion of the hydrogen gas which rises with the water. The peculiarities of this locality are, *first*, the escape of that gas into the atmosphere; *second*, the development of a great deal of caloric; *third*, the copious diffusion of the gases generated by the combustion of coal; *fourth*, the elevation of immense volumes of steam, holding salt in solution. Now, what is the effect of all this on the prevalence of autumnal fever among the agents and operatives? The answer given by the medical gentlemen of the valley is, that those persons are not quite as liable to the disease as the people who reside away from the furnaces. The inhabitants of Charleston appear to suffer but little from it.

VIII. The Kenawha Basin, taken as a whole, is too rugged and unproductive to admit of a dense population. The inhabitants will be chiefly in its narrow valleys and mountain glades. Much of it must forever remain a wilderness.

The LITTLE KENAWHA, which joins the Ohio sixty or seventy miles above the Great Kenawha, so closely resembles it in geology and topography, that a separate description is not necessary. Above the mouth of this river, where we find the town of Parkersburg, the left bank of the Ohio presents nothing of interest to the etiologist until we reach the old town of Wheeling; which, however, I shall describe in connection with the banks of the river above, after having first completed the survey of another, and the last hydrographical basin south of the Ohio River.

## SECTION XIV.

### BASIN OF THE MONONGAHELA RIVER.

I. OUTLINE DESCRIPTION.—The Monongahela is the southern of two nearly coequal rivers, which unite at Pittsburgh to form the Ohio. Its basin lies between that of the Kenawha and that of the Alleghany, north of the former and south of the latter. An account of it will finish the description of the southern half of the Ohio Basin.

The Monongahela River is composed of four subordinato streams: *First*, The West Branch, which originates in the south-west, where it interlocks with the sources of the Little Kenawha, and of Elk River, a tributary of the Great Kenawha. Its course is nearly north-east. *Second*, The East Fork, or Tygart's Valley River, which interlocks, in sources, with the Gauley and Greenbrier, and running north unites with the West Branch. *Third*, Cheat River, lying further east, originating on the slopes of Cheat Mountain, where it is connected with the head of Greenbrier River, whence it runs northerly to join the common trunk of the last two branches. *Fourth*,

The Youghiogheny, north-east of the Cheat, which flows to the north-west, and joins the common trunk below that stream.

Every part of the Monongahela lies within the coal measures of the Appalachian carboniferous formation, and it has the distinction of being the largest river of the Great Interior Valley that begins and ends within those measures. Coal is found in every part of the basin, and the rocks are sandstone, shale, and that limestone which is found within the coal series.

The surface of this basin is less elevated and rugged than that of the Kenawha, yet its south-eastern portion is mountainous, with some cultivable valleys and table-lands or glades. The remainder, which has a population of considerable density, is characterized by Doctor Hildroth in the following terms: \*

"The streams are turbid, and tortuous in their course; and as they descend to the valley, they become slow in their progress. The springs are few and small, and readily affected by the droughts of summer. The hills are irregular in their height, and in their arrangement, but they are generally very fertile, covered with a rich argillaceous soil to their very summits, and produce a luxuriant vegetation, such as is usually found only on rich alluvions; they are invariably clothed with forest trees of the most lofty height."

Neither the assemblage of small rivers which constitute the Monongahela, nor the main trunk itself, can be regarded as alluvial, for their bottoms are in general narrow. Some of the tributaries, however, flow for a distance in the broad synclinal axes or valleys which lie between mountain ranges, of which the following is an example:

II. TYGART'S VALLEY.—"One of the most interesting spots in the topography of this region," says Doctor Hildroth,† "is Tygart's Valley. It lies near the heads of the 'Valley River,' twenty miles south-east from Clarksburg; Beverly, the county seat of Randolph, lies in this valley. It is about seventy miles long, including that portion on Leading Creek, and in breadth it varies from one to three. Its boundaries are formed by ranges of the Cheat and Laurel Mountains, rising to a great height, and affording many proofs that this valley has once been occupied by a lake. The accumulated waters, rising above the elevation of the Laurel range, have here forced a passage, and the Valley River, and Leading Creek, have formed for themselves channels in the bed of this ancient lake. This passage is about three miles in length, and from three to four hundred yards in breadth, cut down to the base of the mountains. The cliffs of rock on each side are of a stupendous height, not less than one thousand feet, affording a most grand and picturesque view, and may not inappropriately be called 'the gates of the mountain.' The fissure in the rocks and strata on each side correspond; affording sufficient evidence of their former junction. The rock itself is of the coarsest conglomerate sandstone. Additional evidence of this valley having formerly been the bed of a lake, is also found in the fossils brought up in excavating the earth for wells. \* \* \* The base of the valley

\* Silliman's Journal, *loco citato*.

† Ibid.



raises very gradually as it advances toward its head in the Cheat Mountains. The river meanders through its whole length with a calm and placid surface. Environed by ridges of lofty mountains, and shut out from the strife and tumult of the surrounding world, this valley affords, at certain seasons of the year, all the natural and picturesque beauties of the fabled valley of Johnson. Here may be found nearly all the rare and curious shrubs and flowering trees indigenous to the western country. \* \* \* Numerous waterfalls and rapids, below the 'gates of the mountain,' give to this sequestered spot, by their noisy contrast, a still greater air of tranquillity. In the distance of twenty-five miles, the river has a descent of several hundred feet, as it passes down the broad plateaus of the mountains into the valleys below. Much of this descent is made up of rapids and ripples, but in other places it forms perpendicular cascades, and pitches over the sandstone rocks, which generally form its bed."

III. THE GLADES OF CHEAT AND LAUREL MOUNTAINS.—We have already noticed the glades around the Gauley Basin. Those which are found in the region we are now exploring, belong to the Cheat and Laurel Mountains, and are described by Doctor Hildreth as follows: \*

"The whole face of the country becomes elevated, and between the ranges of mountains we meet with long but narrow strips of level land, here called 'glades.' They, in some respects, resemble the prairies of the west, being clothed with a scanty growth of forest trees and shrubs, but are composed of a rich vegetable soil, well suited to the growth of grain, potatoes, and grass, but are too much elevated and subject to late frosts, for the successful cultivation of Indian corn. They were, without doubt, once the beds of lakes, and have uniformly a stream of water passing through their most depending portions. The table-lands of Mexico are here represented in miniature. The glades were once portions of the original bed of the ocean, before the mountain ranges were lifted up, or 'brought forth,'—but at that period were elevated with the ranges to their present height. Being surrounded by ridges, they, for a long time, remained covered with water, until, by accumulations from the adjacent highlands, the water forced a passage through some less elevated spot, and draining off by degrees the accumulated flood, its bed was eventually laid bare, which bed now forms a modern glade."

IV. BUCHANAN.—The town bearing this name is situated about the thirty-ninth degree of north latitude, on the left or west bank of a small river of the same name, which discharges its waters into the East Branch of the Monongahela. In its rear, to the west, as I am informed by Mr. White, a student of medicine, there is a considerable tract of bottom, which is liable to overflows, and continues swampy; yet neither intermittent nor remittent fevers occur.

V. CLARKSBURG.—This is one of the oldest towns of the Monongahela Basin. It is scatteringly built on a small tract of uneven table-land, on the left bank of the West Branch of the Monongahela. The stream sinks very

low in summer, has a rocky bed, and but little side-alluvion. Its elevation above the sea is between eight and nine hundred feet. That of the immediately surrounding hills is about two hundred more. The region in which this town is situated is rugged, with narrow valleys, transient streams, no swamps or ponds, and but few springs;—the sub-strata are shale and sandstone, with seams of coal and very little limestone. On traversing this region from the west, I was told by the people that ague or intermittent fever is unknown, or nearly so; but that every fall they have 'the fever,' by which they meant remitting bilious fever, tending to a continued type. In Clarksburg, I conversed with the venerable octogenarian, Doctor Williams, who had resided there forty-seven years, and he assured me, that ague and fever had never prevailed through that long period, and had scarcely ever occurred sporadically, in the town or its vicinity. Even along the West Branch of the Monongahela, he had never seen a case. Every year, however, he had witnessed more or less of remittent fever. This representation was confirmed by Doctor McCally, who had also practiced in Clarksburg for many years. The agues he had seen were contracted elsewhere; but remittents occurred scatteringly every autumn, on hill and valley alike, and were, now and then, moderately epidemic.

VI. KINGWOOD. — From Clarksburg to Kingwood the general course of the road is to the north-east. It crosses the East or Tygart's Valley Branch of the Monongahela. I found the country dry, the streams transient, and the springs neither numerous nor permanent. Between the west and east branches of the river, the surface is hilly, though not more elevated than around Clarksburg; but beyond the latter branch, the hills become loftier, and the general surface at length rises into low-mountainous. The chief population is in the narrow valleys, where remittent fever occurs to a moderate extent; but intermittent is almost, if not quite, unknown.

Kingwood, like Clarksburg, is seated on a piece of table-land elevated about two hundred feet above Cheat River, which flows a mile and a half from it, on the north-east. Beyond the river is Cheat Mountain. The site of Kingwood is, by estimate, twelve hundred feet above the sea. The surrounding country, in its aspects and vegetation, is wild and alpine; composed of carboniferous shales and sandstones, deeply cut into ravines; and overspread with lofty forests, which embrace kalmias, laurels, rhododendrons, pines, and chestnuts; while its cool and darkly embosomed waters abound in speckled trout (*Salmo fontinalis*), unknown at a lower level, or further west in the valley of the Ohio. It is almost unnecessary to say, that in this region ague and fever does not occur. All with whom I conversed (including Doctor Kidwell and the Hon. Mr. Brown, of Kingwood), testified to this fact. It is, indeed, a popular opinion there, that localities which abound in trout are exempt from ague. Mild remittent fevers, however, occur occasionally every autumn, in that as well as other parts of the Monongahela Basin, but not to the same extent as in its western portions.

VII. SMYTHFIELD, ON THE YOUGHIOHENEY. — This humble village is situated on the right bank of the river, where it is crossed by the National Road, near

the eastern base of the Laurel Mountain. The bottoms of the stream, like those along the other branches of the Monongahela, are of limited extent. They are less elevated, by two or three hundred feet, than the plateau on which Kingwood stands. From Doctor Fetter, who had resided in this locality for five years, I learned that he had seen but one case of intermittent fever. It occurred on the river bank, a mile below the village. Remittent fever is, however, a yearly visitor, and appears on the mountain-flats as much as in the valley. Once it assumed an epidemic character, but it has generally been sporadic.

VIII. LOWER BASIN OF THE MONONGAHELA. — The lower portions of this valley, and that also of the Youghiogheny River, are no longer mountainous, but constitute a hilly and rolling plain, which stretches off to the Ohio River, from the base of Laurel Hill, the most western of the Appalachian group. Monongahela county, in Virginia, and the counties of Greene and Fayette, with large portions of Washington, Westmoreland, and Alleghany, in the state of Pennsylvania, compose the civil divisions of this limited, but not unimportant, district, which is, properly, the beginning of cultivable country, in coming into the basin of the Ohio from the east. It is traversed by the National Road from the foot of Laurel Hill, through Uniontown, Brownsville, and Wheeling, to the Ohio. That portion which lies near the mountain is more depressed and level than some others. In advancing to Brownsville on the Monongahela, the surface seems to rise and become more rugged. The river, at Brownsville, is seven hundred and thirty-six feet above the sea, and the surrounding hills appear to be, at least, four hundred more; giving them an altitude of nearly twelve hundred feet. Farther west the country rises, almost imperceptibly, to the height of fifteen or sixteen hundred feet, at Hillsboro, and then sinks gradually to Wheeling, where it does not exceed eleven hundred feet. The principal ravines which have been cut through this district, are those in which the two principal rivers approach and unite, the Youghiogheny yielding up its name, and contributing, by its waters, to prepare the Monongahela for more equal union with the Alleghany, in forming the Ohio River at Pittsburgh. The ravines through which these rivers flow are generally narrow, and comprehend, of course, but little alluvial bottom,— the common character of all the streams of the district. A series of locks and dams has produced slack-water in the Monongahela, from Pittsburgh to Brownsville; between which the difference in level is thirty-two feet.

Much of this district has a calcareous basis and a fertile soil. Its springs are neither numerous nor permanent. It has no swamps, nor any ponds, except those produced by mill-dams, or the subsidence of the streams until they degenerate into pools connected by feeble currents. Chartier Creek, which originates near Washington and flows into the Ohio a little below Pittsburgh, has wider alluvions than the Monongahela, and some of them show small ponds and sloughs; on the whole, however, this district may be placed among the driest in the basin of the Ohio. Being one of the oldest-settled portions of the basin, its forests have been extensively destroyed.



My information concerning its liability to autumnal fever is the following. At Uniontown, near the base of the mountain, I learned from Doctor H. Campbell and Doctor Fuller, that intermittent fever is nearly unknown in that part of the district, and that patients coming with it from other localities often recover without the use of medicine; but remittent fever occurs sporadically every autumn, and in the year 1819, Doctor Campbell saw it epidemic. In some cases remissions were distinctly marked, but in others they were obscure, and there was a tendency to a continued type. At the Fair Chance ironworks of Mr. Oliphant, seven miles south of Uniontown, near the base of the mountain, intermittents among the operatives were never thought of. At Brownsville, which is built on steep river-hills, that remind one of Vicksburg, Doctor Stanley, Doctor Lafferty, and Doctor Jones, through periods of fourteen, eleven, and four years, had never seen a case of ague and fever, until after the construction of locks and dams for slack-water navigation created a pool, the head of which was near the town. These cases, observed by Doctor Stanley, were, however, few in number, and were accompanied by chills only. Cases of ague from a distance had sometimes proved obstinate; and periodical neuralgias of the brow are not uncommon. Remittent fever is of annual recurrence here, but not, strictly speaking, epidemic. It has frequently shown a tendency to the continued form. In Washington, Doctor Lemoine, in a practice of twenty-five years, had seen but five original or indigenous cases of intermittent fever, two of which were of the town, in a house which had water in the cellar throughout the summer; the other three were near a mill-pond. Doctor Wishart, in the course of a long practice, had seen very few cases, except those contracted abroad. Doctor King had seen a case, in June, in a man who had sojourned in an aguish locality the preceding fall, without then having an attack. All these gentlemen testify to the annual occurrence of remittent fever, but not as an epidemic, except in the neighborhood of some of the streams which abound in ponds. It often assumes a typhous character, and never terminates in an intermittent type. To this testimony I may add that of Doctor Reed, who, although not in practice, had long been an attentive observer in this locality. In the neighborhood of West Alexandria, between Washington and Wheeling, among the sources of Buffalo and Wheeling Creeks, where the surface is tortuously rolling and low-hilly, with good springs and without swamps or ponds, Doctor Davidson, in a practice of eight years, had never seen a case of ague or intermittent; and even remittents appear to be replaced by continued fever; which prevails more in autumn, however, than in other seasons of the year. These observations, extending through this district from the mountains to the Ohio River, a distance of seventy miles, will be sufficient to show the degree to which it is affected by autumnal fever.

IX. WHEELING.—The course in which we have traveled, has brought us back to the Ohio River, at the town of Wheeling. The direction of the river at this place is nearly south-west. The town stands on its left bank, above high-water mark, on two alluvial terraces—a lower and an upper—neither of which is very wide. The lower is composed chiefly of sand and

gravel, the upper of sandy loam. These terraces are traversed by Wheeling Creek, which divides the town itself into South and North Wheeling. The creek originates not far to the south-east, where it interlocks with a tributary of the West Branch of the Monongahela. As it approaches the town it winds among the hills, has narrow bottoms with high banks, not liable to inundation; but it receives the back-water of the Ohio when in flood. Immediately opposite the town, there is a large island, which is so elevated as to admit of being highly cultivated. Beyond this island, the hills press hard upon the river, and have an opening or ravine from the west, through which Indian Creek makes its way to the river. Thus, Wheeling, for a river town, is favorably situated, as to the conditions which generate autumnal fever. The elevation of its site is about seven hundred and sixty feet above the sea; that of the surrounding hills, not far from eleven hundred. As to ventilation, it cannot be acted upon with effect, except by winds from the north-east, or south-west and west.

Wheeling, in N. Lat. about  $40^{\circ}$ , is one of the oldest towns of the Ohio Basin; its population is about ten thousand souls; it has many factories and consumes a vast quantity of sulphuro-bituminous coal, drawn from the adjacent hills.

When Doctor M. H. Houston,\* to whom I am indebted for most of these particulars, removed to Wheeling, in 1831, and for two years afterward, intermittent and remittent fevers prevailed to a considerable extent, and were much commoner on the upper than the lower terrace; owing, no doubt, to the latter having the densest population. After an invasion of epidemic cholera, in 1833, these fevers nearly disappeared, and have not since returned, except in the mildest degree. When at Jefferson City, Missouri, (p. 168) Doctor W. A. Davison, who had practiced medicine in Wheeling from 1837 to 1840, confirmed this statement, by saying that he found the fevers of autumn, in his present locality, decidedly more frequent and dangerous than he had found them in Wheeling. A comparison of the topography and relative ages of the two towns will explain this difference. Doctor Houston is unable to designate any topographical changes cotemporary with the cholera of 1833, except a more general paving of the streets, and the substitution of hydrant-water for well-water. The same gentleman has noticed that, in such portions of the hill-country around Wheeling as have a clay surface with a prevalence of oak trees, the fevers of autumn are of a more violent character, than in any other part of this locality.

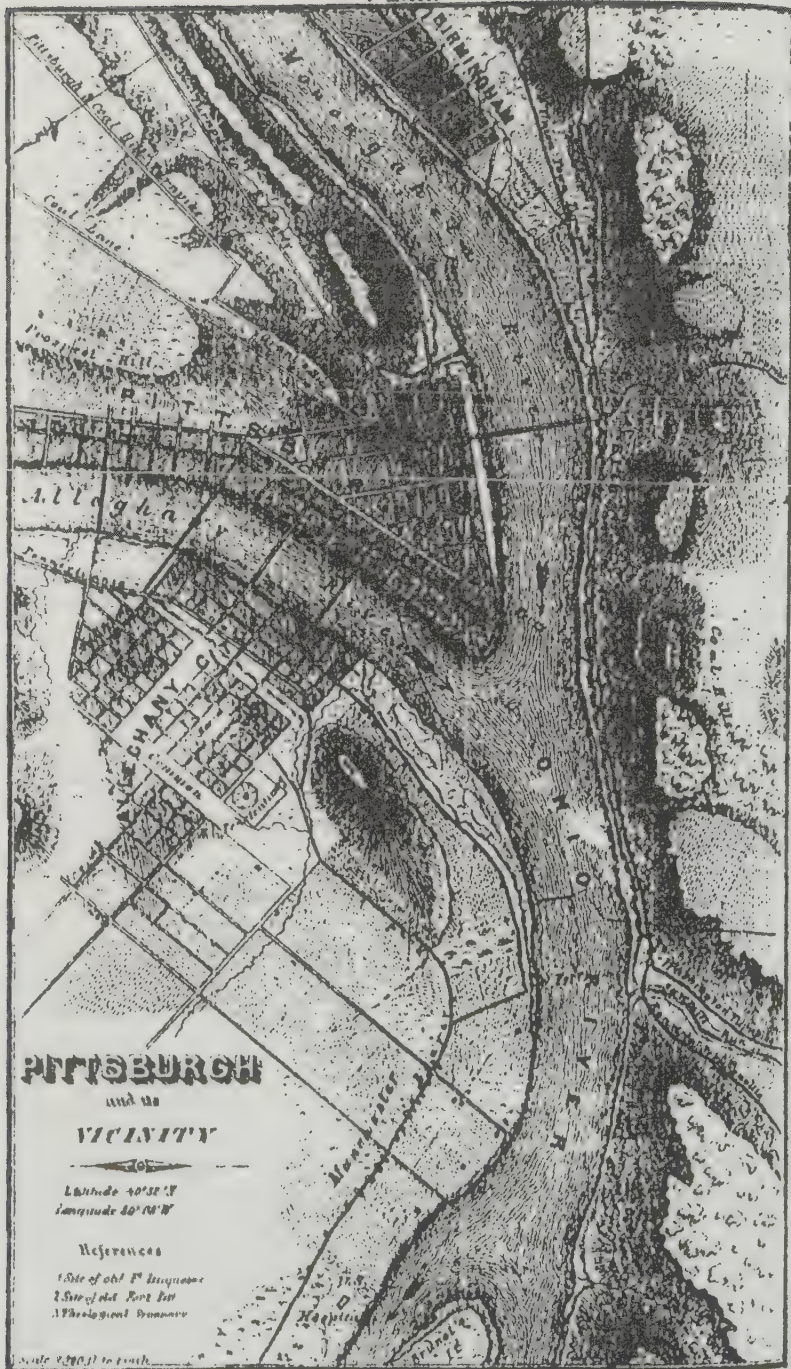
X. FROM WHEELING TO PITTSBURGH.—The distance between these places is ninety miles. In ascending from the former to the latter, the voyage, for half the distance, is directly north, then north-east, and then, for thirty miles, south-east. Thus, a kind of promontory is formed, the surface of which is deeply cut with ravines, giving hills, the summits of which are about eleven hundred feet above the sea, until we approach Pittsburgh, when they rise still higher. As a general fact, there is no marsh and very little

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\* MSS. penes me.







# **PITTSBOROUGH** and the **VICINITY**

Latitude 40° 52' N  
Longitude 40° 00' W

## **References**

- 1. Site of old Fort Mifflin
- 2. Site of old Fort Mifflin
- 3. Theological Seminary

Scale 1:100,000 to front

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C. J. Miller D. S. C. King

bottom-land in this peninsula, except along the Ohio and the lower portions of Chartier Creek, where there are sometimes partial inundations. On the upland portions, the exemption from intermittent fever is as great as that of the Monongahela Basin from Uniontown to Washington, of which, topographically, this tract is a continuation. No important town stands on the left bank of the river above Wheeling. The most noted is Weirsvana. I know of nothing peculiar in its topography. Doctor Grafton, with whom I met in Millersburg, Kentucky, resided nine years in Weirsvana, during which he saw but one case of indigenous ague and fever. Remittent fever prevailed to some extent, and in one autumn almost assumed an epidemic character; but other autumns passed without a single case.

## SECTION XV.

### PITTSBURGH AND ITS DEPENDENCIES.

I. The western metropolis of Pennsylvania belongs equally to the banks of the Monongahela and the Alleghany Rivers, as it stands on the promontory or point of land above the junction by which they form the Ohio (*Pl. XII*). An account of its topography will finish the description of the southern half of the Ohio Basin and introduce us to the northern.

The latitude of this city is  $40^{\circ} 35' N.$ ; its longitude  $80^{\circ} 14' W.$  The low-water elevation of the adjoining rivers, is seven hundred and four feet above the sea, and one hundred and forty above Lake Erie; the different plains or terraces on which the city and its surrounding towns and villages are built, vary in elevation from a few feet below high-water, to forty or fifty above it. The neighboring hills rise to different heights, up to four hundred and sixty-seven feet above the rivers, making the general summit-level of the surrounding country about eleven hundred feet above the ocean. An inspection of the topographical map (*Pl. XII*) will afford important aid in the study of this locality.

On the south or left-hand side of the Monongahela River, we see a range of steep hills, rising almost from its margin to the height of four hundred and sixty-five feet above low-water. They continue in this proximity for several miles below the city; but above it recede, so as to give a tract of argillaceous bottom-land, on which the manufacturing town of Birmingham has been erected. Most of it rises above the highest floods of the river. In front of it, is the first of the series of dams and locks which extend up the river to Brownsville.

For a long period of time the town was limited to the point of land above the junction of the rivers, which, as I was informed by Mr. Iohbaum, and other old citizens, abounded in ponds and sloughs, now filled up and built over. In the rear of the town the hills are near, and soon after reaching their summits the observer finds himself in the dry bed of what was once a small, shallow lake, tortuously stretching off to the north-east, under the name of East Liberty Valley. Its elevation, as I was informed by Edward



Miller, Esq., Civil Engineer, is one hundred and seventy-five feet above the Pittsburgh plain, which would make it about nine hundred and fifty feet above the sea. The hills which surround it rise about one hundred and fifty feet higher, that is, to the general level of the country. A deep stratum of loam with rich soil overspreads the bottom of this obsolete lake; on which huge water-worn bowlders are scattered, indicating the fact, that this locality belongs to a different geological and topographical region from that of the south side of the Monongahela River. Before leaving this spot, I may remark, that Judge Wilkins, who resides in its midst, assured me that intermittent fevers do not occur among its inhabitants, and that remittents are extremely rare. This exemption should perhaps be ascribed, in part at least, to the great length of time it has been cultivated, for an elevation of nine hundred and fifty feet, and a latitude of forty degrees thirty-five minutes, are not sufficient to countervail the morbid influence of a flat and fertile surface, abounding (originally) in organic matter, and adequately supplied with moisture.

When we look from the hills to the south of this locality, up the valley of the Monongahela, we see a deep ravine, with abrupt and closely-approximated hills, in harmony with the general character of the upper portions of the Ohio Basin on the south side of the river; but when we look down, to the north and north-west, upon the Alleghany River, we find it meandering through broad alluvial and diluvial bottoms, with hills of gentler slope. On examining these plains we soon discover that they are not (like those to the south) composed merely of the disintegrated strata through which the river has flowed, but abound in sand, gravel, pebbles, and bowlders, detached from rocks of a much older geological date, than the carboniferous, among which they are deposited; and have, like the bowlders in the dried-up little lake just described, been transported hither by vast currents from the north. Such is the valley which stretches up the Alleghany River from Pittsburgh, and through which the Pennsylvania Canal has been excavated. Three miles from the city, on the left bank of the Alleghany River, stands the United States Arsenal. The bottom over which the road to this military post lies, presents some brick-ponds, and is partially overflowed in ordinary river floods; but these spots are to the north-east or leeward of the city. Captain Harding, who commanded the station, and Doctor Day, an aged army surgeon, assured me, in 1847, that autumnal fevers are almost unknown among the soldiers and operatives of the arsenal; and the people of the adjoining village of Lawrenceville enjoy, I believe, nearly an equal exemption. The road to the arsenal passes over a terminal basin of the canal, in the northern suburb of the city. The water in this basin, from the absence of an outlet, is stagnant, and foul in appearance; yet, as Doctor Addison and Doctor Speer assured me, it has not generated either intermittent or remittent fevers, in those who reside around it.

The bottom which has been described, lies on the east or Pittsburgh side of the Alleghany River; but below, a still wider bottom becomes developed on the opposite or right side, which continues for three miles down the Ohio.



This, as may be seen on the map, is the site of Alleghany Town. A narrow strip of this bottom lying along the shore, both above and below the junction of this river with the Monongahela, is so low as to suffer inundation, and displays a foul and wet surface, which, in some places, is pondy, though on a small scale. The canal which, by an aqueduct, supplies the basin on the opposite side of the river, continues through the upper half of this bottom, when it discharges its water into the Alleghany. In its rear, there is a higher terrace—an old or second bottom—which, like other plains of the same geological age along the Ohio River, abounds in rolled and polished fragments of the primitive rocks of the north. This terrace does not, however, extend back to the hills, which lie at the distance of nearly a mile, but soon declines into a kind of superficial valley, through which it is obvious the Alleghany, or a part of its waters, when of much greater volume than at present, once flowed to the Ohio, two or three miles below its present junction with the Monongahela. Of course this ancient bed is not as free from watery surface as that part of the plain which has not been thus cut down.

Immediately below the junction of the Alleghany with the Monongahela, near the right-hand shore, there were formerly two islands, the upper strata of which have been washed away till they are no longer visible, except when the river is low. The surfaces which are there exposed abound in sand. Opposite to them, at a short distance from the river, an oval eminence rises one hundred feet above the plain, and has been made the site of a public theological seminary. It was an island when a part of the Alleghany flowed to its north. Its composition is the same as that of the surrounding hills, of which it is at once a remnant and a monument.

A mile below is the village of Manchester, partly built on portions of the plain which are, to some extent, liable to submersion when the Ohio is up; and also retain water in shallow ponds, after rain. In proceeding farther down the river the higher terrace disappears, and the adjacent hills come nearer to the river. The surface of the lower bottom still remains so high as to escape all except extraordinary floods; but a permanent swamp over-spreads much of its breadth, and stretches with it along the river, becoming wider as it advances. Near the upper end of this swamp the United States commercial hospital has been erected. Opposite the swamp is Bruno's Island—a part of the bottom cut off from the rest by the current.

From the junction of the Monongahela and Alleghany, the Ohio or common trunk takes a direction nearly north-west, with the hills on the south side approaching it closely for several miles from the city. Thus the south and south-west winds flow down upon Pittsburgh and its progeny of villages, from a terrace four hundred feet above them. When the west and north-west winds prevail, they come over the hospital-swamp, and bear its exhalations into the towns above; by which Manchester and the south-western part of Alleghany Town suffer much more than Pittsburgh; which is more remote, has the Alleghany River interposed to its windward, and is compactly built,—conditions favorable to protection against paludal influences.

All the physicians of Pittsburgh and Alleghany Town with whom I conversed, agree in representing that the intermittent fevers of this locality may be traced up to the low grounds and the swamp to the west and north-west; being more frequent near them, in proportion to the population, and diminishing as we recede from them. Doctor Smith, of Alleghany Town, assured me that, although there is much wet and foul surface about the termination of the canal, it does not seem to produce intermittent fever; so true is it that swamp is the prolific source of that form of fever. and that towns have great capacity for resisting it. Remittent fever prevails over the same tract with intermittent, and also beyond; for it occurs in Pittsburgh, where intermittents are now nearly unknown, and, indeed, seem never to have prevailed to much extent.

While the north-east and north-west winds, traversing the valleys of the Alleghany and Ohio Rivers, ventilate Pittsburgh and its villages very effectually, the winds of summer, from south-east to south-west, have but little power in that way; but, at the same time, they bring less of impure air than they carry into any other town on the banks of the Ohio.

In connection with ventilation, I must refer to the factitious atmosphere, generated in this locality by the combustion of stone-coal. Coal-Hill, the rampart on the south side of the Monongahela, abounds in strata of the very best bituminous coal, in horizontal beds, above the level of the city and its *faubourgs*. To this, in a great degree, may be ascribed the establishment of factories requiring fuel, for which this place has become so famous. Of their number it is neither possible nor necessary for me to speak; but the quantity of bituminous coal consumed in this locality is greater, I suppose, than in any other on the continent. The amount, as I am informed by Doctor Denny, is estimated at ten millions of bushels annually. As yet, very little of the smoke arising from these fires is consumed, and consequently it escapes in immense volumes, carrying into the atmosphere its carbonaceous matter, carbonic acid, carburetted hydrogen, and perhaps sulphurous acid, all of which hover over the city and its environs the longer, from the obstacles to free ventilation which the surrounding hills oppose.

As in other towns of the West, through the early periods of settlement, the people of Pittsburgh, previous to the year 1827, drank well-water; since that time they have drunk the water of Alleghany River, supplied through a system of hydrants. To this time, however, the inhabitants of Alleghany Town, nineteen thousand in number, and those of the other *faubourgs*, use well-water chiefly.

Pittsburgh is the oldest Anglo-American town in the basin of the Ohio. In 1754, the French from Canada built *Fort du Quesne*, at the junction of the two rivers which form the Ohio. In 1758, they were expelled by the colonists, and the name was changed to Fort Pitt. In 1760, the buildings for residence were commenced; and in 1765, a town-plot was surveyed. The present population of the city and its suburban towns and villages is estimated, as Doctor Denny informs me, at eighty-five thousand, of which a plurality, I believe, are Irish, either by birth or extraction.

## CHAPTER X.

## THE SOUTHERN BASIN, CONTINUED.

MEDICAL TOPOGRAPHY OF THE REGIONS EAST OF THE MISSISSIPPI: BASIN OF THE OHIO ON THE NORTHERN SIDE OF THE RIVER.

## SECTION I.

## BASIN OF THE ALLEGHANY RIVER.

1. A line drawn through the center of this basin, from Pittsburgh to the middle sources of the Alleghany River, would run about north north-east, traversing two degrees of latitude, and ascending through seven hundred feet of altitude, from low-water mark at Pittsburgh. In many places the immediate valley expands into broad alluvial and diluvial bottoms, abounding in the *debris* of primitive northern rocks, but in other places wild and rugged hills compress it on both sides. The country west of the river bears considerable resemblance, in aspects and altitude, to that west of the Monongahela, but is more broken. To the east of the Alleghany it has a sharper and loftier hilliness, which graduates into the Chestnut Ridge, and other outer ranges of the Appalachian Mountains; though the elevation attained is nowhere as great as that of the region in which the Cheat River branch of the Monongahela has its origin. All the large tributaries of the Alleghany, except French Creek, are found on its eastern side. The shorter descend from the western slopes of Chestnut Ridge; others originate in the valley between it and Laurel Hill; while some have their sources beyond the latter, in the western escarpments of the Alleghany range, and out through both the other ridges. Of this kind is the Kiskiminitas or Conemaugh, which enters the Alleghany thirty miles from Pittsburgh, and by its valley affords a passage for the Pennsylvania Canal through both the Chestnut Ridge and Laurel Hill — as the valley of the Youghiogheny is expected to afford a way through the same for the Chesapeake and Ohio Canal. These hydrographical facts show that Chestnut Ridge and Laurel Hill are not boundary mountains of our Great Valley, but are really included in it. Its true limits are, in fact, the Alleghany Ridge in Pennsylvania and northern Virginia, while in the southern part of the latter state, and in North Carolina, the Blue Ridge is its actual terminus or rim. The medical etiology of



the Interior Valley has, then, within his own jurisdiction, a broad alpine region, running through eight degrees of latitude, with a mean elevation of fifteen hundred feet above the bed and banks of the Mississippi, to which it is parallel; and the time will come when a comparison of the two belts, in the physiology and diseases of their inhabitants, will be regarded as a work of deep interest. Unable to visit any part of the region lying between the Alleghany River and the Alleghany Mountain-crest, or to meet with publications illustrating its medical topography or diseases, I must content myself, at this time, with indicating it to others, as a field comparatively unexplored by the physician. Of the other, or western side of the Alleghany Basin, I can say something from personal observation and inquiry.

II. From Pittsburgh to Franklin, at the mouth of French Creek, the road, running nearly north, passes over a country of ridges with occasional plateaus. The streams have more of interval or bottom-land than those of the Monongahela Basin. The general elevation of the country is about the same as around Pittsburgh. The whole distance is within the carboniferous formation, but the seams of coal are thin, for the margin of the formation lies but a little further north. From Doctor Dewolfe and Doctor Melunkin, of the town of Butler, thirty miles from Pittsburgh, I learned that, although intermittent fever is almost, if not absolutely, unknown in the town (notwithstanding there is a stream and mill-pond close to it on the south-east), still there are parts of the country in which that disease occurs in a much more decided manner. Remittent fever is not uncommon, and often shows a leaning toward a continued type.

III. FRANKLIN.—The site of this town, once the place of a French military post, is a beautiful diluvial terrace, at the junction of French Creek with the Alleghany River, on the south or right-hand side of the former, and more in connection with it than with the latter. The plain is extensive enough for a large town, and neither subject to inundation nor infested with swamps. Its elevation above the sea cannot vary much from eleven hundred feet, nor that of the surrounding hills from four hundred more, making their general level fifteen hundred feet. French Creek flows down an alluvial and diluvial valley, which, at an ancient geological period, conveyed a large river. Several years since it was locked and dammed, the effect of which on the autumnal health of the inhabitants was bad. From Doctor Gillet I learned that intermittent fever, generally of a tertian type, prevails in this valley every year; commonly mild, but sometimes accompanied with protracted coldness and reluctant reaction. It does not extend to the plateaus of the hills. Remittent fever is less common, and often terminates in the other variety, instead of a typhous condition. In the last week of July, I was shown cases of intermittent fever by Doctor Gillet.

IV. WARREN.—Up the Alleghany for seven miles, to the mouth of Oil Creek, the river is closely compressed by the hills. Oil Creek flows through a broad valley. At its mouth the road ascends high and barren hills of conglomerate, the rock which underlies the coal basin,—from which we have now escaped, after having repeatedly entered and traversed it, from the

Tennessee River, in the thirty-fourth degree of north latitude. From the summits of this out-crop, the elevation of which cannot be less than seventeen hundred feet, we gradually descend, over plateaus and ridges, into the valley of the Alleghany, which, from this point, for a great distance down (as I was told), is very narrow, the river struggling through a labyrinth of hills, covered with pine, hemlock, and chestnut. Ascending the valley from this point, it continues narrow for several miles, when we approach the mouth of the stream called Broken Straw, where it becomes as broad as that of the Ohio. The elevation of this alluvial plain is eleven hundred and sixty-seven feet above the sea.\* On passing this spot, the bottom contracts a little for six miles, when we reach the town of Warren, on the right or west bank of the river, in latitude forty-one degrees fifty minutes north, at an elevation of eleven hundred and eighty-five feet;† the conglomerate and sandstone hills around, attaining, by estimate, the altitude of sixteen or seventeen hundred feet. These hills, in every direction, are destitute of a single stratum of limestone, and the water which they supply is soft. Warren is situated on a beautiful semi-lunar bend of the river, within which, on the opposite side from the town, there is a low, broad, wooded bottom, subject to inundation. The site of the town is a diluvial terrace, elevated above high-water mark of the river; but having some portions of its back part swaley, from springs which burst out of the adjoining hill. Immediately above the town, the outlet of Chautauque Lake, called Conewango Creek, joins the river from the north. The water of both streams is dark-colored, a sign of its having flowed through or from tamarack swamps. Near their junction, there are patches of bottom, which are overflowed by the freshets of the Alleghany. Warren, the most beautiful of all the mountain villages, is one of the *emporia* of the pine-lumber trade. As to intermittent fever, Doctor Sargent and Doctor Irvine assured me that it is nearly unknown; nor does it occur on the broad bottom at the mouth of Broken Straw. Remittent fever prevails to a limited extent only. In a population of twelve hundred, there are, in some autumns, four cases at one time. They are so mild and manageable, that neither of the gentlemen had seen a fatal case for twelve years. Nor is it replaced by typhus fever, which is quite as rare as the remittent. It is not easy to assign a reason for the very different prevalence of intermittent fever at Franklin and this place.

V. CONEWANGO CREEK AND CHAUTAUQUE LAKE.—In ascending the Conewango, which is but a mill-stream, its valley is seen to be as wide or wider than that of the Ohio, abounding in diluvial terraces of various elevations, and composed largely of pebbles and boulders, many of which are granite, and have been transported thither from the north. For the first nine or ten miles the stream has a rapid fall. Then, suddenly, the valley widens to three times its previous breadth; the rapid creek becomes a deep and sluggish canal; broad, low, flat, and fertile bottoms spread out; and the adjacent hills exchange their rugged aspect for one of gentle rotundity, and,

\* Reports on the Erie and Sunbury Railroad. By Ed. Miller, Civil Engineer.

† *Ibid.*

losing their oaks, and chestnuts, and whortleberries, present groves of sugar-maple, walnut, beech, and other trees of a like kind, with which white pines, as lofty and abundant as on the poorer soils, are strikingly blended. This remarkable transformation of surface and scenery discloses two facts:—*First*, That we have passed through the final out-crop of the conglomerate, and come upon the Devonian sandstone and slate, which have emerged from beneath; *Second*, That we are in the bed of an obsolete or drained lake, which was once connected with Chautauque Lake, but at a little lower level. Through this dry lacustrine bed, the Conewango, which at times overflows portions of it, has an extensive meandering and circuitous course, in sight of which the road is continued over a series of high diluvial terraces and low slate ridges, until it reaches JAMESTOWN, in the state of New York, at the eastern end of Chautauque Lake. The whole distance from Warren to this place is twenty miles, and the dividing line between Pennsylvania and New York crosses nearly equi-distant between them.

I have spoken of the Conewango as an outlet of Chautauque Lake; but it has an independent existence, and originates to the north-east of that lake, above the latitude of forty-two degrees, whence it descends into the obsolete lake-bed, and unites with the outlet of Chautauque Lake. The bottom-lands of this large creek and its tributaries, before it reaches that locality, are broad and depressed, covered with hemlock, and subject to inundation. They bear, in fact, a close resemblance to the wide, low, and wet interval lands of many of the smaller streams in the cretaceous and tertiary formations of Alabama and Mississippi, near which, as we have seen, autumnal fevers of the most malignant character are generated.

Chautauque Lake is twenty miles long, and from one to three or four broad. Its figure is serpentine; its western extremity reaches within fifteen or twenty miles of Lake Erie; the country around it slopes beautifully down to its margin; in some places terminating in a bluff bank, in others sinking to the level of the lake before reaching it, and thus creating swamps, into which rivulets discharge their waters, and on which those of the lake are sometimes blown. On a small stream called Goose Creek, which meanders through one of these swamps, I saw a mill-dam with a pond of the foulest aspect. The altitude of this little lake is twelve hundred and ninety feet above the level of the sea, and seven hundred and twenty-five above Lake Erie, although so near it. The average height of the surrounding ridge-summits, is estimated by Doctor Hazeltine, who resides upon one of them to the south of the lake, at two hundred and sixty more, or fifteen hundred and fifty above the sea; which may be taken as the summit-level of the long belt of rolling table-land that stretches from a point considerably east of Chautauque Lake to an undefined termination far west; resting on the Devonian sandstone and slate, as on a broad terrace; and constituting, beyond comparison, the most interesting region to be found at the same elevation east of the Mississippi; with the sources of which river it corresponds in elevation. It is worthy of remark, that boulders of granite of



great size, as well as deposits of rolled pebbles, are found in the superficial valleys, and even on the highest ridges of this table.

JAMESTOWN, on the left-hand bank of the outlet of the lake, is built on the gentle slope of a low hill, and is free from any contiguous swamp, except some small tracts produced by a mill-dam near the town. The settlement of this place began in 1815. Its population is about two thousand.

VI. Let us now turn to the autumnal health of this extensive and interesting locality. At a corresponding elevation among the waters of the Kanawha and Monongahela, we found neither lakes, ponds, swamps, nor alluvial bottoms, of any considerable extent, and could not, therefore, ascribe the limited prevalence of autumnal fever there to mere elevation; here, however, we have the whole of those surface-conditions in latitudes the same with regions lying to the west, which are seven or eight hundred feet below this locality; which regions, as we shall hereafter see, are greatly infested with autumnal fever. The difference, then, between this spot and others west of it, in regard to autumnal fever, can be ascribed only to difference in elevation. Let us inquire how great this difference is. From Doctor Hazeltine, who came hither at the commencement of settlement, I learned that, for the first three years of his residence, he did not see a case of intermittent fever. The disease then made its appearance, and prevailed moderately for three years, and then began to decline. The type was mostly double tertian. Other diseases during that period displayed something of a periodical character, and several enlarged spleens fell under his notice. Through the same period, remittents occurred, and were prone to end in agues. They, also, became fewer, *pari passu* with intermittents, and for several years he had not seen a case of either. He lived in Jamestown, but his observations were extended over the whole locality.

From Doctor Eldarkin, who has long resided on the margin of the Goose-Creek swamp, near the mill-pond which has been mentioned, I learned that occasional cases of both intermittent and remittent fever occur in their vicinity; but neither disease has ever prevailed in that locality, although so well-fitted, topographically, to produce them; and in latter years their occurrence has become still rarer.

By Doctor Axtell, who had resided for twenty years in the obsolete lake-bed south of Jamestown, and practiced medicine there for the last five years, I was informed that, throughout the whole period, he had scarcely heard of a single intermittent. All that he had seen, amounting only to three or four, had been contracted elsewhere. Remittent fever occurs, but with great rarity.

These various statements were strengthened by the observations of Doctor Hazeltine, junior, and of gentlemen out of the profession, as communicated to me on the spot. The Conowango and its branches, before that stream enters the obsolete lake-bed which has been described, flow through wide alluvial lands, abounding in hemlock swamps. In one of these valleys, that of the Little Conowango, stands the village of RANOLDEN, fifteen or eighteen miles north-east of Jamestown; at which, I was assured, they never have

either intermittent or remittent fever. Nearly forty miles farther to the north-east, in latitude about  $42^{\circ} 20'$ , at Ellicottville, on the banks of Great Valley Creek, a tributary of the Alleghany, the elevation being about fourteen hundred feet, I was assured by Doctor Williams, who had resided there nineteen years, that intermittent and remittent fevers are unknown; and Doctor Stanton, after a shorter residence, confirmed the statement, except that he had seen what turned out to be continued fevers, commence with obscure remissions.

We find, then, that in the latitude of  $42^{\circ}$  N., the topographical conditions which originate autumnal fever, are nearly overcome by a mean altitude of fourteen hundred feet; but we have previously seen that, in the basin of the Kenawha, among the mountains of Virginia, at an elevation of eighteen hundred feet, Professor Rogers saw many cases of intermittent fever. This is to be ascribed to the difference of latitude, that locality being about four degrees farther south than the table-land in the vicinity of Chautauque Lake.

VII. FRENCH CREEK. — The extreme sources of French Creek are hard by Chautauque Lake, on the rolling table-land just described, and also within a few miles of Lake Erie. Its course is first to the south-west, and then to the south-east, and the town of Meadville is included in the bend thus formed. Its eastern tributaries interlock with those of the Broken Straw and of Oil Creek, before mentioned as affluents of the Alleghany, which they join between Franklin and Warren. The elevation of this little region is about fifteen hundred feet; and many of the summits present extensive tamarack swamps,\* but of its liability to autumnal fever I cannot speak. As French Creek descends from this elevation, passing near Waterford, the old French post of *Le Boeuf*, it appears like a dull, dark canal, meandering through wide interval lands, abounding in hemlock swamps, and in many places overspread with drift and boulders from the north. The adjacent rounded hills are composed, like those near Chautauque Lake, of Devonian slate and sandstone. With this character it continues to Meadville. From that town down to Franklin, at its junction with the Alleghany, the valley of this creek presents wide alluvial bottoms, but the people living on them were generally exempt from autumnal fever: in the language of Doctor Ellis, that disease was scarcely known. During the years 1832, 1833, and 1834, however, the series of locks and dams already mentioned under the head of 'Franklin,' was constructed, converting the river into pools as far up as Meadville. The (apparent) effect of this proceeding was the generation of intermittents and remittents, and their annual prevalence to such an extent, along the whole line of pools, that in 1843, the inhabitants destroyed all the dams. But the autumnal sickness continued to recur, and in 1844 spread on the neighboring hills, many cases presenting a congestive or malignant character. In 1845 and 1846 a similar state of things returned; but in 1847, the year of my visiting this locality, the fever was replaced by dysentery; many cases of

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\* Report on Erie and Sunbury Railroad. By E. Miller, Civil Engineer.

which, however, demanded the same treatment as intermittent fever. The average height of this valley is about eleven hundred feet above the sea—its latitude  $41^{\circ} 30' N$ . According to Doctor Ellis, in the valley of French Creek, above Mondville, where locks and dams were not erected, and both the elevation and latitude are something higher, autumnal fever scarcely occurs.

VIII. MEADVILLE.—This is the most noted town within the basin of Alleghany River. It stands chiefly on a low, flat, left-hand bottom of French Creek, but has also extended upon a higher diluvial plain. A small stream traverses the lower terrace. Two or three miles above the town French Creek has been dammed, and a canal, supplied from the pond thus created, passes through the town, and, is afterward, by a great *détour* to the west, made to terminate in Conneaut Lake, of which an account will be given presently. In summer and autumn nearly all the water of French Creek passes along this canal, so that its bed, immediately to the south-west or windward of the town, would be nearly dry, but that a tributary enters from the west, below the dam. The elevation of the lower part of the town site is eleven hundred and forty-five feet; that of the surrounding hills (composed of Devonian slate and sandstone, capped with conglomerate) is, on an average, four hundred and fifty-five feet higher, making their altitude above the sea sixteen hundred feet.\* Its latitude is about  $41^{\circ} 40' N$ . As to autumnal fever, I was assured by Doctor Ellis and Doctor Yates, who had resided in the town nearly twenty years, that intermittent fever was almost unknown until after the excavation of the canal which passes through it. The water was let into it from the dam above the town, and suffered to stagnate in it, for the canal was not used. Then it was that the fever began to make its appearance, and has continued to return annually ever since.

We have seen, in Sec. VIII, of Ch. IX, that the erection of locks and dams on the upper part of the Kentucky River, although three degrees farther south, and six hundred feet nearer the level of the sea, was not followed by an increase, but a diminution of autumnal fever. To what shall the difference of effect be ascribed? I know of nothing but the comparative topography of the two valleys. The upper Kentucky River flows through a rocky trough, with deep shore-waters, and margins generally free from organic matter; but French Creek runs in a broad alluvial valley, many parts of which were doubtless overspread with sheets of shallow water resting on a soil abounding in decomposable materials.

\* Rogers's Third Annual Report on the Geology of Pennsylvania.



## SECTION II.

## BASIN OF BEAVER RIVER—CONNEAUT LAKE—BEAVER AND ERIE CANAL.

I. GENERAL DESCRIPTION.—The region designated by these titles, lies west of the Alleghany Basin, in Pennsylvania, and east of the Muskingum Basin, in Ohio. It brings us upon a lower and leveler surface; which is, in fact, a continuation on the north side of the Ohio, of the region between Brownsville and Wheeling. The eastern portions of this basin have a hill-elevation on the Ohio River in the south, of twelve hundred feet, rising gradually, as we go back, to fifteen hundred, but declining to eleven hundred, and even one thousand, as we pass to the west from Butler and Crawford counties, Pennsylvania, into Trumbull county, Ohio. The water-levels of the canal and principal branches of the Beaver, rise from seven hundred to eleven hundred feet.\* We shall see that these details make a necessary element of the medical topography of this region. East of Beaver River, the more elevated surface is rugged; west of that river it becomes much leveler, and presents us with the eastern extremity or commencement of a flat water-shed, which extends westwardly (gradually becoming lower) until it reaches the sources of the streams which flow into the Mississippi.

The Beaver, and its great elementary branches Shenango and Mahoning, flow through wide valleys which abound in alluvial and diluvial terraces. Many of them originate in extensive swamps, which impart a dark color to their water, and large tracts of bottom-land, annually overflowed, are left with sloughs and shallow ponds. Autumnal fever prevails throughout.

II. CANALS AND CONNEAUT LAKE.—A canal ascends the Beaver Valley, from its junction with that of the Ohio, thirty miles below Pittsburgh, to the town of New Castle, about thirty miles up, where the Mahoning, the Shenango, and the smaller Neshanock unite. The common trunk there bifurcates; and while the western branch passes up the Mahoning for Cleveland, the other continues up the Shenango, directly north, to the town of Erie. On its way it passes hard by the western end of Conneaut Lake, which is on the summit-level, and supplies both extremities of the canal with water. Of the damming-up the outlet of this lake, and the introduction of water by a feeder from above Meadville, I have spoken in the last Section. This proceeding, as Doctor Ellis informed me, raised the surface of the lake eleven feet, and caused the overflow of its banks with shallow water to the extent of several thousand acres; much of which, in summer and autumn, when the streams supplying the lake were low, was laid bare by the drawing off to supply the canal. At the same time, the water in the broad alluvial outlet of the lake became stagnant, from the arrest, by the dam, of the current into it. In addition to this, near the south-west portion of the lake, there was a tree-swamp through which the Shenango passes, and a dam was thrown across both the stream and the lower or south end of the swamp, the trees on which

\* Pennsylvania and Ohio Geological Reports.

were cut down. In this way a shallow supplementary reservoir was created.

The effects of this breaking-up of the natural relations between the land and water, were of the most disastrous kind, and by no means limited to the inhabitants living near the margins of the water, but were felt for several miles off, in all directions. They were, however, much worse on its shores than at a distance. In visiting this locality with Doctor Ellis, we came to the village of Evansburg, near the dam at the head of the natural outlet of the lake, and found it literally depopulated. But two or three persons were seen in its streets. In continuing our drive beyond, we passed through the midst of deserted plantations; where, previously, as in the village, the inhabitants had enjoyed good autumnal health. When we reached Hartstown a village on the Shenango, at the other dam, Doctor White confirmed all that I had been told, and added many details concerning the sickness of that part of this locality. While there I met with Doctor Bardwell, of Harmanburg, a village on the canal near the north-west extremity of the lake, who gave me a similar account; and has since, by letter, added, that the fevers and dysenteries of summer and autumn had been rendered most malignant; being accompanied by sloughing or gangrenous ulcers, hemorrhages, and a fatal sinking of the vital powers. He could not decide which had been most pernicious, the shallow inundation of dry land, or the draining of swamp-surfaces into the canal, which had taken place in some parts of this devoted locality; which, it is proper to add, lies in north latitude  $40^{\circ} 35'$ , and has an elevation above the sea of eleven hundred feet.

III. MERCER.—Thirty miles south of Meadville and Conneaut Lake, stands the town of Mercer, on hill land, where the Neshanock has its sources, and whence it flows to the south-west, and joins the Shenango, at New Castle. From the valley of this stream, which makes its way through strata of crumbling shale and soft sandstone, within the coal basin (into which we have returned), there arise exhalations, which generate many cases of autumnal fever, both in and around the town. Doctor Magoffin, long resident there, has been accustomed to meet with malignant intermittents, and has seen dysentery, palpitation cordis, and cephalalgia assume a distinctly periodical character.

IV. PULASKI.—This village is seated on the left bank of the Shenango, which has alluvial bottoms. The canal passes through it, and there is, also, a dam across the river, creating a pond of remarkably black water. Doctor Wood, who came to the village in its infancy, thirteen years before my visit, informed me, in 1847, that for several years intermittents were unknown. The public works, which I have mentioned, were then constructed, and intermittents began to appear, and have spread over the adjoining hills. Mr. McGuffay, who resides a mile above the village, on the west or windward side of the mill-pond, informed me, that his family occupied that spot for thirteen years before a case of intermittent fever appeared among them, and it then began in the spring of the year.

V. NEW CASTLE.—From Pulaski to New Castle, ten miles, the broad

alluvial and diluvial valley of the Shenango has, in latter years, become infested with intermittents. The canal has caused an overflow of many low spots. New Castle stands on a dry plain, at the junction of the Shenango and Neshanock. Doctor Cossitt and Doctor Gamble informed me that intermittents had greatly increased in latter years.

From these various testimonies it would appear, that the excavation of the Beaver and Erie Canal has been productive of much injury to the health of the inhabitants.

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### SECTION III.

#### Basin of the Muskingum River.

I. TRANSITION FROM BEAVER TO MUSKINGUM RIVER.—Although the sources of these rivers interlock, on the summit-level between the Ohio River and Lake Erie, their mouths are one hundred and fifty miles apart. Through that distance the course of the Ohio is south south-west. Its bottoms are of the ordinary breadth and elevation for the upper part of the river, and do not merit further notice. On one of them stands the town of STEUBENVILLE, of which I am not able to say anything. The adjacent zone of upland demands a more extended notice. It is very narrow, for the Muskingum River presses it on the west. The counties which are comprehended in it, are Columbiana, Jefferson, Harrison, Belmont, Monroe, and part of Washington; all in the state of Ohio. In topographical features this zone is an extension of the western part of the lower basin of the Monongahela River, in Pennsylvania and Virginia. The town of Wheeling lies nearly opposite its middle. Most of its streams flow into the Ohio; but the western part of each county, except Jefferson, gives origin to creeks, which, taking a western direction, with a sluggish current, become tributary to the Muskingum. They are flush in rainy weather, but dry up, or fall very low, in summer and autumn. Those of Columbiana county are the most permanent. The springs are sufficiently numerous, and tolerably durable, but never copious; they commonly burst out above or below the coal seams. There are no ponds or swamps, and the bottom-lands are, in the main, too narrow and destitute of alluvion to exert much sinister influence. On the whole, this long narrow belt is one of the driest in the Ohio Basin. Its surface is everywhere rolling or steep-hilly, with an average summit-elevation of eleven hundred feet; while some parts of Belmont county rise to the altitude of twelve hundred and eighty-four feet, and are, therefore, among the highest in the state of Ohio.

Doctor Thomas Carroll, to whom I am indebted for much of this information, and who practiced his profession for seventeen years in this district, and has written on its topography and diseases,\* informs me, that in the whole time he did not see more than four or five cases of intermittent fever;

\* Western Journal, Louisville, January, 1842.



and those, he thinks, were contracted elsewhere. Remittents, however, are not so rare, and often assume a typhous character. In his paper he remarks: "Take the country for twenty miles west of the Ohio, and extending from the Pennsylvania line to Marietta, and, I apprehend, no district between it and the Mississippi, has so great an exemption from these fevers; and no country could be much better calculated to restore to perfect health constitutions partially broken down by remitting and intermitting fevers." It is interesting and instructive to note this autumnal salubrity, in connection with dryness and elevation of surface. The mean latitude of the locality is 39° 30' N., in which parallel, at a lower level, and with a different kind of surface, intermittent and remittent fevers prevail, in a very decided degree, as they also do along Benvor River and its branches, up to Conneaut Lake, a degree further north.

II. THE MUSKINGUM VALLEY UP TO ZANESVILLE.—From Doctor Hildreth, of Marietta, I have received the following notices of the topography of the lower part of the Muskingum Basin. "The river from its falls, at Zanesville, passes nearly south-east, through a hilly region. In some places, its shores rest against the foot of the hills, or approach so near, that there is between them but a narrow strip of alluvion. In others, the bottoms expand to the width of half a mile, but, on the whole, are much narrower than along the upper portions of the river. The back parts of most of these bottoms are lower than the front, and in many places, covered with water from the spring rains, or the river freshets, by which marshes and ponds are left through summer and autumn. In the progress of settlement many of these tracts have been ditched and drained, whereby a great diminution of intermittent and remittent fever has been effected.

"The whole of this portion of the river has been subjected to slack-water improvements, on the effects of which I have made the following observations. Where the banks are high and bold, the autumnal health of their inhabitants has been improved. The heads of islands and sand-bars, which, formerly, were exposed to the action of the sun, as the river fell in August and September, are now kept covered with water. Where the banks are low, and the back parts of the bottoms swaley, the keeping up of the surface of the river, by the dams, prevents the surface-water from flowing off after the rains of spring; and remaining to be slowly evaporated during the hot weather, the people are made more sickly. On the whole, however, the dams have done more good than harm to the health of the inhabitants. It has not been observed, that those who live near the dams, over which the water falls, are more unhealthy than those who live between them, which is contrary to what was the popular opinion. The inhabitants of the hills, only a few miles from the river, are never affected with intermittents, unless they sojourn on the bottoms. As to the geology of the lower part of the basin, from Marietta for some distance up, the hills are composed of soft argillaceous sandstone, of the coal formation, and the bottoms in a great degree of their *detritus*. Beyond this, we come to an out-crop of limestone from the south, which stretches off east and west, in its line of bearing,

with a width of twenty or thirty miles. This rock gives a very different character to the hills, which, instead of being clothed with oak timber like those of the sandstone formation, produce sugar-tree, beech, poplar, and other trees and shrubs, similar to those which are found on the bottoms."

The lower or southern part of the Muskingum Basin is uncommonly narrow, as it is encroached upon by the Ohio to the east, and Hocking River to the west.

III. UPPER MUSKINGUM BASIN.—Immediately above Zanesville, this basin spreads out to the east and west, until it becomes broader than any other in the state of Ohio; and is watered by many beautiful streams, which flow through wide alluvial and diluvial bottoms, abounding in organic matter. The largest of these streams are the Licking, which enters the Muskingum on its west side opposite Zanesville, and the Walhonding and Tuscarawas, which, by their union at Coshocton, form the Muskingum. The two latter originate on the table-land which divides the waters of the Ohio from those of Lake Erie, about north latitude forty-one degrees. This table-land may be regarded as a continuation, at a lower level, of the table-land around Chautauque Lake, at the sources of the Alleghany River, in New York. This portion of the Muskingum Basin lies north of the coal formation, on Devonian slate and sandstone, and has a general elevation of one thousand feet above the level of the sea. It contains many ponds or small lakes, and numerous cranberry swamps, some of which are of great extent.

The diluvial deposits, consisting of matters brought by ancient currents from the north, are in this region very broad, and not confined to the valleys (which near the sources of the streams are shallow), but bury up much of the Devonian or sub-carboniferous strata of the uplands. In entering this region, we arrive, distinctly, at the prairies, which, as we shall hereafter see, stretch westwardly to the Mississippi River, becoming greater in extent, proportionally to the woodland, as we advance. The whole of the upper Muskingum Basin is not level. The greatest flatness of surface is found in the northern range of counties—Stark, Wayne, and Richland. South of these, as we approach the conglomerate which underlies the coal, the country becomes broken, and swales and marshes are fewer in number; the streams, however, continue to flow through wide bottoms, which in many places are liable to inundation. As a general fact, it may be stated, that intermittons and remittents prevail over every part of the upper basin.

After these general views, we must bestow some attention on a few localities.

IV. OHIO AND ERIE CANAL.—This canal, which passes from Cleveland, on Lake Erie, to Portsmouth, on the Ohio River, enters the upper Muskingum Basin, at the sources of the Tuscarawas, in the north, and passes out to the south, after traversing the valley of Licking. As it was excavated between 1825 and 1830, it is not practicable, at this late period, to ascertain the modifications of autumnal health which attended or followed that operation; and, as it has been carried along streams, through alluvial grounds, its present influence is so mixed up with theirs, as to defy analysis. As to the

health of the boatmen, I was assured by a number, that they are less subject to autumnal fever than the people who reside on the banks of the canal. Their statements seemed to be made in good faith; and if we admit the fact, we may conjecture, that the watery surface over which they constantly live exerts a protective influence. Where the canal leaves the Licking, to pass into the Scioto Valley, there is an extensive artificial reservoir, designed to supply water to the canal, of which it will be proper to say something.

*The Reservoir.*—The latitude of this receptacle is very near forty degrees. Its elevation above the sea eight hundred and eighty-nine feet. Its area several thousand acres. A part of this reservoir was a natural lake, the rest a wooded cranberry swamp. The surrounding embankment is composed of earth, taken from the surface without, so that there is an exterior belt of low ground, kept wet by percolation from the reservoir. From a portion of the inclosure the forest was removed before the water was let in, but left undisturbed on the other. Through the first summer after the surface was submerged, the trees maintained their verdure; in the second, they had a sickly aspect; and before the ensuing spring, were dead. When I saw them in 1840, they were dropping their decayed limbs into the water, and many of them had been blown up by the roots. The landscape wore a peculiar and melancholy aspect of desolation. By Doctor Ewing, and other gentlemen of the neighboring village of Hebron, I was assured, that the people in the vicinity of the reservoir have suffered less from autumnal fever, since its construction, than while the spot was a swamp. The reservoir is chiefly supplied by the South Fork of Licking River, most of whose waters are turned into it. Before this diversion, that stream, in the spring of the year, overflowed its bottoms, but not since; and the people who live near it have become healthier in autumn than formerly.

The contrast of this statement, with that in the preceding section, concerning the Conneaut Reservoir, is so striking, as almost to raise a doubt as to the accuracy of both; yet both were made by respectable physicians. Admitting their truth, we are admonished to regard some of the problems of medical hydrology, as more difficult of solution than is generally supposed.

V. CANTON. — The upper Muskingum Basin has many flourishing towns, of which Granville, Newark, Mount Vernon, Mansfield, Wooster, Coshocton, Massillon, and Canton, are the principal; but my notes are too imperfect for use, except in reference to the last, which is not the most important; but its medical topography and autumnal diseases may be taken as representatives of the whole; for they are all built on alluvial or diluvial terraces.

Canton stands in latitude 40° 38' N., at an elevation of about nine hundred feet above the level of the sea. The site of the town is the point of land immediately above the junction of the East and West Forks of Niniashillin Creek, an eastern tributary of the Tuscarawas. The plain is diluvial, and above the reach of inundations by the streams; but the immediate banks of the streams are alluvial, wet, and swampy, while their currents are sluggish. These low terraces were heavily wooded, when Doctor Stidder arrived.



in the year 1828; but the trees have since been mostly felled, and the ground has become dryer. Much of the drift on which the town is built, has been brought from regions of primitive rock in the north, and rests on Devonian or sub-carboniferous sandstone. The country around is inclined to levelness, and abounds in natural ponds, mill-ponds, and swamps. In the early period of Doctor Stidler's practice in this place, both the village and the surrounding country were greatly infested with intermittents and remittents, which were sometimes malignant: but, under the influence of clearing and cultivation, they are less prevalent. Still, in conversation with Doctor Whiting, on the 16th of September, I found that he then had thirteen patients with intermittent fever, all residing, however, in the country, on the borders of streams or marshes. He described cases of as malignant and fatal a type, as any which are generated on the banks of the Cahawba or Pearl River, eight degrees farther south, and six hundred feet nearer the level of the sea. Doctor Estep had observed that remittents were more frequent in the town than intermittents, and prone to become continued.

VI. ZANESVILLE.—This city, the population of which, with its *faubourgs*, West Zanesville and Putnam, is about nine thousand, stands in N. Lat.  $39^{\circ} 59'$ , on a high diluvial terrace, which makes the east or left bank of the Muskingum River, adjacent to its falls, and opposite the mouth of its large tributary the Licking. The elevation of the plain is seven hundred feet above the sea. It lies within the coal basin, and is surrounded by hills, which rise about two hundred feet higher.\* The village of West Zanesville consists of a single street, above inundation, with hills in its rear. The town of Putnam stands on a wider bottom, which is also exempt from submersion, and is bounded by hills. Between them, near the mouth of Licking, some small portions of bottom are liable to occasional inundations. At the falls there are a dam and lock, from which a mill-race or canal has been dug across the most depressed part of the Zanesville plain, and gives some wet surface in the south-western suburbs of the city. The inhabitants are supplied with excellent well-water, and also with river-water, by a hydrant system. Their chief fuel is coal. The country around is broken, dry, and, except along the river, deficient in fertility. From Doctors Moorehead and C. C. Hildreth, whose communications have corrected and enlarged my personal observations, I learn that autumnal fever scarcely occurs in this locality. Through a period of fifteen years, the latter never saw it assume an epidemic character, and most of the sporadic cases had evidently been contracted elsewhere. Near the river margin of the plain, however, in the south-western suburb, where, as we have seen, there is some wet ground, Doctor Hildreth has observed the people to be more affected with that fever than elsewhere.

VII. LICKING RIVER demands a notice. Near its mouth there is a dam, and a second, sixteen feet high, a few miles up the stream. The latter has created a pool several miles in length, from which, when the river is in flood, considerable tracts of alluvial terrace are overflowed. In one of these bot-

\* Ohio Geological Reports.

town, moreover, there is a pond. According to Doctor Moorehead, to whom I am indebted for these facts, there is in this locality a decided prevalence of autumnal fever.

The *Muskingum Pool*, formed by the dam at its falls, nine feet high, extends up to the town of DRESDEN, a distance of fifteen miles. According to the observations of Doctor Moorehead, this pool has not had the slightest effect in producing autumnal fever; but beyond it, at and above Dresden, where there are extensive bottoms, which suffer inundation and abound in stagnant surface-water, the inhabitants are infested with intermittent and remittent fevers. The facts connected with the Zanesville locality are of some importance in reference to the remote cause of autumnal fever, and recall those observed at Pensacola (pp. 52, 53). The summer heat and the atmospheric moisture are both as great, or even greater, in Zanesville, than up Licking Creek, or along the Muskingum above Dresden; and yet the two latter localities are much sicker; indicating that something beyond heat and humidity is required to generate autumnal fever.

VII. MARIETTA.—The town of Marietta is built on a bottom common to the Ohio and Muskingum Rivers, immediately above their junction. A small stream from the hills to the east, traverses the town-plot, and discharges its waters into the Muskingum. When the rivers are high, their waters are backed up this creek, and some portions of the plat are overflowed. The greater part of the plain is, however, above the highest floods. On the opposite side of the Muskingum another and lower bottom constitutes the site of the newer town of HARMAN, in early times the site of a fort. Between the two towns a dam and lock have been erected in the Muskingum, creating a pool, which extends several miles up the river, and makes a part of the slack-water system which has been described. Up the Ohio, above the town, there is an extensive and highly cultivated bottom; nearly opposite the town is the lower end of a long island.

The low-water elevation of the Ohio at the mouth of the Muskingum is five hundred and sixty-six feet above the level of the sea, or two feet higher than the surface of Lake Erie. The plain on which the town is built rises from fifty to eighty feet higher, giving it an average of six hundred and thirty feet above the sea; while the surrounding hills, present a mean elevation of two hundred and seventy more, or an altitude above the ocean of nine hundred feet. These hills are composed of the soft sandstones and shales of the carboniferous formation. The latitude of the town is  $39^{\circ} 25'$  N.,—its longitude  $81^{\circ} 20'$  W.

Marietta enjoys the distinction of being the first spot at which an Anglo-American settlement was made in the northern half of the Ohio Basin. Here, on the 7th of April, 1788, began the civil and political existence of the North-western Territory, since divided into the states of Ohio, Indiana, Illinois, and Wisconsin. Its original inhabitants were a colony from Massachusetts, and as the town has not grown beyond a few thousand, it presents no varieties of physiology.

In the early period of its settlement, this locality was infested with au-

tummal fever up to the average degree; but with the progress of cultivation and civil existence, that malady has suffered the usual abatement.

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## SECTION IV.

### THE REGION BETWEEN THE MUSKINGUM AND SCIOTO RIVERS: HOCKING RIVER.

I. From the mouth of the Muskingum to that of the Scioto, the distance by the Ohio is one hundred and seventy-five miles, while many of the upper tributaries of those rivers meander in the same localities. For a considerable distance they run nearly parallel; then the Muskingum diverges to the east, and enters the Ohio; which afterward flows far to the south-west and then to the north-west, before the Scioto, by a directly southern course, unites with it. The region between the lower portions of these two rivers is that now under examination. It has a long connection with the Ohio river; lies, as it were, in a great bend; but does not run very far back. If not the most elevated, it is the most rugged and sterile portion of the state of Ohio. Geologically, it constitutes a part of the brim of the great Appalachian coal basin; and when we pass out, at any point between north and west, we leave that formation and come upon the Devonian conglomerate sandstone and slate, which dip to the south-east, beneath the coal measures. This district abounds in iron, salt, and coal; and, of course, embraces large classes of operatives, exposed to whatever etiological influences belong to their respective pursuits. The principal river of this region is the Hocking, which, originating near its northern margin, where the surface is comparatively level, takes a south-east course and unites with the Ohio not far below the Muskingum. The alluvial bottoms of this tortuous stream, hidden, as it were, for much of its distance among the hills, are wide, and many of them so low as to be subject to submersion when the river is swollen. The next in size, and only other considerable stream, is Racoon River, which joins the Ohio much lower down than the Hocking. It likewise is skirted with broad low bottoms; which is also the case with a still smaller tributary, Symmes' Creek, which enters the Ohio further down.

All these alluvial valleys are infested with intermittent and remittent fevers; while the hill-country, generally, is almost exempt, especially from the former. A few words concerning two or three towns of this region, must suffice.

II. LANCASTER.—This town is built on the left bank of the Hocking, near its source. The site is an alluvial plain, rising upon high diluvium. On the western or right side of the river, there was a low prairie, in which the stream meanders with a sluggish current. A canal now passes through the town. The substratum is Devonian slate. Autumnal fever formerly prevailed here to a decided degree, but has long been on the decline.



III. POMEROY.—The site of this town is a narrow, Ohio-river terrace, encroached upon, in the rear, by soft, sandstone, mural bluffs. The terrace is above high-water mark. On the opposite side of the river, there is a wider and lower wooded bottom, in which there are some ponds. Two miles below the town, the terrace expands into a considerable plain, some portions of which are subject to inundation. Near the upper part of this plain is the mining village of Coalport, inhabited almost exclusively by the operatives who dig for coal in the adjacent hill. In the new town of Pomeroy autumnal intermittents are few and simple; and the people of Coalport are almost as exempt; but the inhabitants of the wide bottom below them are subject to that disease.

IV. GALLIPOLIS.—This old, and, originally, French town, stands twenty miles below the last. It was settled in 1791, by immigrants from Paris. Its site, very nearly in N. Lat.  $39^{\circ}$ , is a high and ample alluvial or diluvial terrace, so level that, in its natural state, the surface was poney. Above the town there is a wide and lower bottom, the margin of which near the river is dry, but further back there are ponds and swales, especially in the vicinity of a small stream called Campaign Creek, which there enters the Ohio. In this part of the locality, as I was told by Doctor Maxon and Doctor Hubbard, autumnal fever is much more prevalent than in any other. Immediately below the town, a creek, known by the name of Chickamargo, enters the Ohio, having alluvial bottoms, which are subject to inundation when the river is in flood. Six or eight miles to the north-west of Gallipolis, Racoon River and Campaign Creek approach within a few miles of each other. The table-land between them is called the Pine Plains, and includes the village of Porten. The streams have alluvial bottoms, portions of which are liable to submersion. From Doctor Sisson, one of the physicians of this village, I learn that autumnal fever invades every part of the plain, not even sparing the village.

*Yellow Fever.*—Gallipolis is the only town of the Ohio Basin which has been charged with generating yellow fever. As much depends, in reference to the origin of that disease, on the truth of this imputation, it is necessary to inquire into the proofs. The plain on which the town is built was covered by a heavy forest when the Parisian immigrants arrived, and its wet surface was charged with organic matter. As the trees were cut down, and the sun admitted upon the surface, the new-comers fell sick of the fevers which everywhere appear under such conditions, in the latitude and at the elevation (about six hundred feet) of this place. The summer and autumn of the year 1797, seem to have been seasons of great mortality; during which Mr. Ellicott\* arrived there on his voyage to Natchez, and reported to the editors of the New York Medical Repository, besides recording it in his journal, that the disease was yellow fever. Previously, and about the time of his visit, that fever had prevailed in Philadelphia and New York, and was held

\* Journal of Andrew Ellicott, Commissioner for surveying the boundary between the United States and Florida.

by many physicians to be only the highest grade of our indigenous autumnal fever. At that time the malignant or congestive remittents, with which we are now familiar in the West, had not fixed the attention of the settlers; who, before the invention of steamboats, did not seek the river-bottoms, as they have since. Mr. Ellicott did not describe this fever in such terms as to show that it really was identical with that which prevailed on the Atlantic coast. In looking at the whole matter, the proofs seem to me insufficient to sustain his declaration; and I suppose the cases which led to it were examples of what is now known over the West and South-west as the malignant remittent fever of the country. To this conclusion I am the more inclined, from having witnessed the autumnal fevers of sickly localities, on the banks of the Ohio, since the year 1800, without having seen a prevalence of yellow fever, though occasional cases have closely resembled that disease. It is the more important to be careful in the examination of this isolated epidemic, of (so called) yellow fever, inasmuch as the adoption of Mr. Ellicott's report, precludes all further inquiry as to the local or indigenous origin of that disease; I will, therefore, add, that the distance from the sea, and the elevation above its surface, not less than the rural instead of urban character of the infant village, all militate against the conclusion that the epidemic was yellow fever.

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## SECTION V.

### BASIN OF THE SCIOTO RIVER.

I. GENERAL VIEWS.—The Scioto is the longest and most central river of the State of Ohio. Its sources interlock with those of the Sandusky of Lake Erie. Its course is almost directly south. Originating among the upper Silurian or gray cliff limestone, in its progress it cuts the out-cropping Devonian sandstone and slate, and finally reaches the Ohio at Portsmouth, in the midst of the conglomerate which makes the foundation of the Appalachian coal basin. Until it enters the last out-crop, its basin is comparatively level, in many parts flat; and this character of surface extends over more than five-sixths of it; the elevation of which is from nine hundred to one thousand feet above the level of the sea.

The larger part of the surface consists of dry and fertile lands, partly wood-land and partly prairie, but it includes several varieties, which deserve to be mentioned; *first*, small lakes or ponds of clear, cold water; *second*, wet or marshy prairies, generally the beds of filled-up ponds; *third*, extensive wooded swamps, which become nearly dry in autumn; *fourth*, sloughs, or 'slashes,' as they are called by the inhabitants, of small extent, overshadowed by water-maples and gigantic white elms, supporting a luxuriant growth of the *Rhus toxicodendron*, and generally drying up in summer. A specimen of the black soil from one of these sloughs, analyzed at my request by Doctor Raymond, gave the following results:

## IN ONE HUNDRED GRAINS OF BLACK SOIL,

Organic extract, with a trace of nitrate of soda, - - -	2.5
Carbonate of lime, - - - - -	5.
Phosphates of alumina and iron, - - - - -	4.6
Decomposed organic matter, - - - - -	30.
Undecomposed " " - - - - -	18.
Alumina, with a trace of iron and lime, - - - - -	7.
Silica, - - - - -	20.5
Loss, - - - - -	.5
	<hr/> 100.0 <hr/>

The limited elm and maple swales or shallow ponds, one of which afforded the specimen of soil which was analyzed, constitute one of the special features of this basin. I have seen them in but one other locality, and that, although topographically remote, is geologically identical. I refer to the Louisville plain (see p. 247). That terrace, it will be recollected, is composed of the debris of black or Devonian slate, resting on gray limestone. Now, in the upper part of the Scioto Basin we find the eminences capped with the same kind of slate, resting on the same variety of limestone; the strata at Louisville cropping out to the west from beneath the Illinois coal formation; those of the basin we are now examining from the south-east, from beneath the Appalachian coal formation. Disintegrated slate is, then, the *nidus* of these swales; a fact which enlarges our views of the relation between geology and medical topography.

Another feature of the upper or northern portions of this basin, as of the Muskingum (Section III), is an immense deposit of northern drift, by no means confined to the streams, and greatly obscuring the rocky strata.

The Scioto, and nearly all its tributaries, flow through wide valleys, but little depressed below the level of the country, until we come into the lower or southern part of the valley, where the bottoms are still wide, but the valleys are cut deep into the sandstone, slate, and conglomerate formations. Generally in the valleys there are two, and sometimes three terraces; the lowest of which may be called alluvial, is commonly wet, and frequently suffers inundation. The others are above high-water mark, consist chiefly of sand and pebbles, and may be regarded as diluvial. When the river, in the south, enters the hilly part of the basin, its bottom-lands continue of great width, and suffer under spring floods; but those of the smaller streams become much contracted. Some points in this portion of the basin, are among the highest in the State of Ohio, as, for example, Hillsborough, in Highland county, which has an altitude of eleven hundred and four feet above the level of the sea, and also the conical summits of the conglomerate hills on the eastern side of the river, in the neighborhood of Chillicothe, and thence to the Ohio River at Portsmouth.

As a general fact, it may be stated that every part of the Scioto Basin, from the beginning of its settlement, has been infested with autumnal fever, both intermittent and remittent, which, although mitigated in the long-eul-



tivated portions, is by no means extinct. A brief notice of a few localities may serve for the whole.

II. WASHINGTON.—This inconsiderable village, the seat of justice of Fayette county, is situate near Paint Creek, a western tributary of the Scioto, at some distance from its junction with the river. The surface of the surrounding country is either level or slightly undulating; prairies and wood-land are intermingled; some of the former are wet and springy, while the latter are divisible into two varieties, open oak-lands with dry and thick soil, and compact diversified forest, abounding in occasional ponds and shallow swamps, which dry up in summer and autumn. The substratum is the upper Silurian or cliff limestone, from which the Devonian slate has been swept off or disintegrated. The rocky strata are generally buried up in clay or gravel. The streams, consisting of the upper branches of Paint Creek, from the general levelness of the country, have a most sluggish current; their low banks are badly defined, and subject to extensive inundations; while their beds are foul, and obstructed with decaying timber. The annual prevalence of autumnal fever, in such a locality, is what might be expected; but my object is something more than to make this known.

*An Epidemic.*—This village stands on the north-east side of Paint Creek. About the year 1820, a mill-dam was erected a short distance above the town, which caused the inundation, to the depth of a few feet, of about sixty acres of bottom-land. As the stream generally fell too low, by the first of June, to admit of grinding at the mill, it was the custom of the proprietors to open the flood-gates and let the water escape, after which the copious showers of that month commonly washed away the recent deposits, and thus the health of the village did not appear to suffer. In the year 1838, the owners did not let off the water until July, and no rains followed to wash away the silt. In a short time an offensive smell was wafted from this foul and drying surface into the village, which was to its leeward, and in the month of August the inhabitants began to sicken with remittent and inter-mittent fevers. In a population not exceeding four hundred, my informant, Doctor Henton, the principal physician, prescribed for nearly eighty, and the village lost eleven of its inhabitants. Those who lived on the streets nearest the pond suffered most. The people who resided in the vicinity, to the west or windward, did not suffer. No epidemic, so severe, had ever visited the village before. It did not cease with the autumn, but continued in the form of winter and spring fevers. In the two succeeding years, up to the time of my visit in 1840, the water had been drained off the first of June, and much of the drift-wood and filth cleared away; apparently, in consequence of which, the epidemic had not recurred.

III. COLUMBUS, the seat of government of Ohio, stands on a broad terrace, which stretches eastwardly from the Scioto River. A narrow slip of lower bottom than that on which the city is built lies between its western side and the river. There are no hills near the city on the left-hand side of the river, but on the right, after crossing the broad low bottom, subject to partial inundation, on which the town of Franklinton stands, we arrive at a

range of hills or bluffs about one hundred feet high. Near the upper part of Columbus, a large affluent, called the Whetstone, pours its waters into the Scioto, through its left bank. To the east of the city, at the distance of a few miles (without any intervening hills), flows Alum Creek, to join Walnut Creek, which afterward enters the river some distance down. From the lower part of the city, a canal, twelve miles long, passes down the river to join the Ohio and Erie Canal. Near the junction of these canals, the surface of the country is flat, wet, and extremely fertile, the consequence of which, as I learned from Doctor Gard, is the annual prevalence of severe and often malignant intermittent and remittent fevers.

To return to the city, it may be said, that although its suburbs and vicinity are in many places wet, and everywhere abundant in organic matter, the prevalence of autumnal fever has not been such as to prevent a rapid growth, which began in the year 1810, up to which time its site was a forest.

The latitude of Columbus is  $39^{\circ} 57' N.$ ; its elevation above the sea, seven hundred and sixty-two feet. The State of Ohio has made here four establishments of interest to the physician—a penitentiary, a lunatic asylum, a school for the deaf and dumb, and a school for the blind.

IV. CUMBERLAND.—The site of this town is a high alluvial or diluvial plain, on the west bank of the Scioto River, about fifty miles from its mouth. The valley here is wide, and presents, in the rear of the town, rounded or flatted hills, with an upper stratum of sandstone, and on the eastern side higher and more conical hills, capped with the overlying conglomerate. To the north, above the town, some portions of the plain are liable to inundation, and near the base of the adjacent hill, to the north-west of the town, there is an extensive pond, supplied with water from the high lands. On the opposite side of the river, above the town, the bottoms are wide, and considerable tracts are subject to overflows from the river; which, moreover, divides into two channels, and forms a low and wet but grassy island in sight of the town. To the west, the plain juts up against the base of the slate and sandstone hills. To the east, it declines toward the river, and presents a tract of low bottom, from which the rains drain off imperfectly, and over parts of which the river rises in every high freshet. This bottom extends down the river to the south, and is traversed by Paint Creek, a large tributary, which flows in from the west, through a wide valley, with low bottoms. At and around the junction of this stream with the Scioto, south south-east of the town, the bottoms generally are depressed, and, although (like the others which have been named) they are now under cultivation, the river-floods and the spring rains give them a wet surface; which, together with their extreme fertility, produces a rank annual vegetation. Finally, to the east, there is a mill-pond, at the distance of a mile and a half; and the Ohio and Erie Canal, with two or three locks, passes through the northern and eastern edge of the town. The redeeming circumstances in this otherwise unpromising topography, are the long range of hills directly to the south-west and west, or windward, of the town; while the extensive and

prolific sources of autumnal fever lie in such directions, that the winds of August and September do not often blow from them to the town. Nevertheless, it is undeniable, that the inhabitants living along even the most populous streets, are liable to autumnal fever, while those of the suburbs, especially below the town, are much more affected by it.

Chillicothe, for many years the seat of government of Ohio, is one of the older towns of the state, having been commenced in the year 1796. From its early medical historian, Doctor Peachy Harrison,\* we learn, that for the first five or six years, it suffered very little from fever; but in 1801 a violent epidemic arose, since which, it has been more or less invaded in the summer and autumn of every year. Its latitude is about  $39^{\circ} 20' N.$ ;—its altitude above the sea, six hundred and forty-five feet.

V. PORTSMOUTH.—On each side of the Scioto, as it approaches the Ohio, there is an extensive bottom. That below the mouth of the river, to the west, is low, extremely rich in soil, abounding in rank weeds, and overshadowed with trees—all of a kind which flourish best in wet situations. Every river-flood inundates this alluvial plain to such depth that it is uncultivable. The Ohio and Erie Canal, so often mentioned, passes through it to join the Ohio by the mouth of the Scioto.

The terrace above or east of the river is so high, that only some limited depressions are liable to submersion. On this plain stands the town of Portsmouth. The river-bench in front is free from topographical nuisances. On the opposite side of the river, the bottom is narrow and closely compressed by a range of steep and very lofty sandstone and conglomerate hills.

The latitude of Portsmouth is  $38^{\circ} 45' N.$ ;—the low-water elevation of the Ohio above the sea four hundred and sixty-eight feet; that of the terrace on which the town is built, about five hundred and forty.

As might be expected, the low bottom, to the west or windward of the Scioto River and of the town, is a prolific and permanent source of insalubrity; and fevers prevail more or less every autumn. According to Doctor Hempstead,† the experienced medical historian of this locality, the paludal influence is so great, that a large number of diseases assume more or less of a periodical type.

West of the Scioto, there is no tributary of the Ohio of sufficient size to demand a notice, until we arrive at the Little Miami, distant about one hundred and ten miles. In running that distance the Ohio bears south of west, as far as Maysville, Kentucky, then west north-west. The tract of country lying in this great bend is hilly near the river, but formed into a kind of table-land at a short distance back, with an argillaceous surface. I can say nothing special of its autumnal fevers.

\* N. Y. Medical Repository, Vol. X, p. 6.

† Proceedings of the Medical Convention of Ohio, 1842.



## SECTION VI.

## THE MIAMI BASIN: CITY OF CINCINNATI.

I. GENERAL DESCRIPTION.—The 'Miami Valley' is the familiar appellation of the united basins of the Great and Little Miami Rivers; which comprehend the south-west angle of Ohio, and much of the south-east corner of Indiana. To the east, the upper tributaries of both these rivers intermingle with those of the Scioto; to the west, all the longer tributaries of the Great Miami arise on common ground with the sources of White River, the largest affluent of the Wabash, the chief river of Indiana; to the north, they interlock with the southern head streams of the Maumee of Lake Erie; and here it is that the basin of the lakes penetrates farthest into that of the Gulf of Mexico. All the southern portions of the Miami Basin are composed of the older or lower Silurian limestone—the blue shell—with a copious interlamination of marlaceous blue shale; the northern parts of the basin rest on the newer or upper Silurian limestone, but much of it is buried up in drift or diluvium, like that of the upper basins of the Muskingum and Scioto. The whole of this portion is either level or undulating; but on approaching the Ohio River in the lower basin, deep ravines give rise to rounded hills, which do not, however, rise above the general level. Both the Miamies, as they descend to the Ohio, present troughs or immediate valleys, which continue wide, and gradually deepen, down to the level of that river. Their descent from the water-shed between the Ohio and Lake Erie is so rapid, that the back-water of the Ohio is only felt ten or twelve miles from their mouths; while on the opposite side of that river it produces stagnation in Licking River to the distance of forty or fifty miles; and in the Kentucky, for seventy-five miles.

The immediate valleys of the Miamies present several terraces or bottoms, rising over each other, and composed, like those of the Ohio, of transported materials from the north. In the spring and early summer, many of the lower bottoms are frequently overflowed. As these streams descend an inclined plain, their currents are rapid, and they present but few stagnant pools, compared with the rivers of the opposite side of the Ohio, just referred to. The upper portions of this basin abound in wet or marsh prairies, wood-land swamps, and ponds, or small lakes of pure water. The southern portions offer but little of either, on the uplands; but in the wide valleys of both the Miamies, and along all their larger tributaries, every variety of wet surface was found in spring and early summer, when settlements were first made: by clearing, cultivation, and draining, however, a much drier condition has been produced. At the same time, mill-ponds have been greatly multiplied, and two canals, one from Cincinnati to Dayton, and thence to Lake Erie, and the other from the former city, to Brookville and Cambridge, in the State of Indiana, have been excavated. In the month of June they are annually emptied of water, and the mud accumulated in their bottoms, is scraped out upon their banks. The canal to Dayton, on starting from Cincinnati, takes up the valley of Millcreek, and, at the distance of

twenty-five miles, enters the valley of the Great Miami. Through the whole distance, it traverses a fertile valley, from one to three miles in width, abounding in diluvial terraces and low alluvial bottoms, to which the present diminutive stream bears, in the volume of its waters, no assignable proportion. This valley is, in fact, the obsolete bed of one of those vast river-currents, which once flowed from the north into the trough of the Ohio River. At that time, the stream which is now called the Great Miami, divided into two mouths, at Hamilton, twenty-five miles north of Cincinnati; and its eastern branch flowed through this valley, near the head of which, there are ponds, which resemble the crescent-lakes of the lower Mississippi, represented in *Pl. V.* A few miles north of Cincinnati, this prong of the extinct river, again divided, and sent off a branch to the east, which entered the Little Miami not far above its mouth; which river then was of great width and depth. This disparity between the present volumes of water and the broad valleys through which they flow, is a common characteristic of the rivers on the north side of the Ohio, from the Appalachian Mountains to the Mississippi; and, hence, the extent of bottom or interval-lands, in the region just indicated, is incomparably greater than in that south of the Ohio, which was never furrowed out by such currents.

The general level of the hill-summits of the Miami Basin is not the same throughout. Along the Ohio River it is from eight to nine hundred feet; at the sources of the Great Miami, from eight hundred and forty-two—the lowest depression at the St. Marys—up to fourteen hundred feet,\* around Bellefontaine, through which the railroad from Cincinnati to Sandusky passes. This protuberance constitutes the highest land in the state of Ohio. As the valleys by which the Miamies reach the Ohio are troughs of excavation, the altitude of their bottoms increases regularly from the principal river, where they are about five hundred feet, up to the summits which have been indicated; the bounding hills regularly diminishing in elevation above the streams. As to position, the Miami Basin extends from latitude 80°, to about 40° 30' N.

Personal observations in the Miami Basin, for forty-eight years, that is, since the twelfth year of its settlement, enable me to say, that it has at all times been subject to autumnal fever; which, along the streams, has been both intermittent and remittent, while on the intervening hills and table-lands, the latter type has generally prevailed.

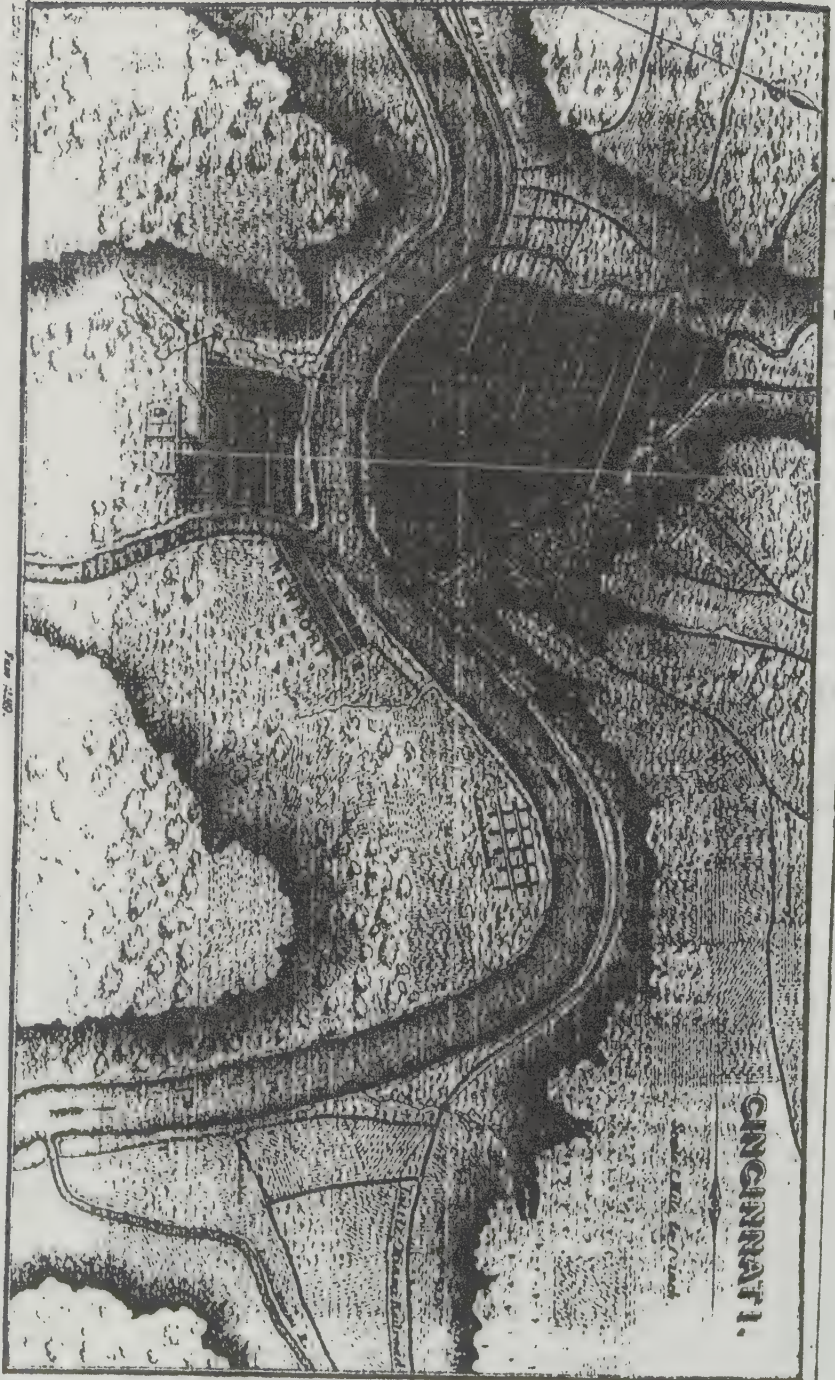
From the earliest period down to the present time, those fevers have been of a simple or inflammatory character, though malignant or congestive cases have not been unknown. The progress of settlement and cultivation has diminished, but not put an end to their annual visitations. This effect is most perceptible in the towns, such, for example, as Hamilton, Dayton, or Springfield, which are at present less infested than in the early period of their settlement. The laborers, by whom the canals were excavated, suffered in autumn from fever; but, living as they did, they would probably

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\* Letters on Geology. By David Christy.

The history of the United States is a story of growth and change. It begins with the first settlers who came to the Americas in search of a new life. These early pioneers faced many hardships, but they persevered and built a new society. Over time, the United States grew from a small colony into a powerful nation. It fought wars, both with and without its neighbors, and emerged as a global superpower. The American dream of freedom and opportunity has inspired people around the world. Today, the United States continues to evolve, facing new challenges and embracing new technologies. The story of the United States is a testament to the human spirit and the power of a united people.





CINCINNATI.

have suffered in the same degree, if not engaged in that employment. It does not appear, that the inhabitants of the regions through which the canals were dug were injured by the process, or by letting in the water when they were finished; nor have I been able to collect any reliable evidence, that the annual emptying and cleaning out, have been productive of fever; which should, perhaps, be ascribed to their receiving but little organic matter. The mud thrown out is, in fact, chiefly the *debris* of their earthy banks.

One of these canals seems, however, to have given origin to autumnal fever in the summer and autumn of the present year, 1848. I refer to the Whitewater Canal, which runs along the river bank, from North Bend to Cincinnati—fifteen miles. From a break in its banks the year before the water was drawn off; and from its bottom abounding in shallow pools left exposed to the sun, through the seasons just mentioned, autumnal fever became epidemic along its whole length (some cases assuming a malignant character), where it had hitherto, for many years, occurred but sporadically.

The Miami Basin—taken as a whole, the oldest-settled portion of the State of Ohio—embraces many flourishing and populous towns; but as their topography is much the same, being nearly all built on river terraces, I shall dismiss them with the general remark, that their suburbs and vicinities are much more infested with autumnal fever, especially its intermittent variety, than their interior and populous streets, and that even the former have felt the ameliorating influence of clearing and cultivation, to a very decided extent.

II. CITY OF CINCINNATI.—When, on the 26th of December, 1788, the third landing for the permanent settlement of Ohio was made, where Cincinnati now stands, there were already in the Interior Valley of North America (between New Orleans and Quebec) more than thirty towns. In sixty years, the encampment of twenty-six men, by the side of a beaver pond, beneath a dense forest of beech trees, has grown into a city, which has a more numerous stationary white population than any other within the Great Valley; and, in numbers, ranks as the fifth city of the United States. Such an unrivaled growth would, perhaps, justify an ample notice of its condition, even if the medical historian were not identified with it in feeling, interest, and early recollections.

A glance upon the map (*Pl. XIII*) will disclose, to the experienced eye, not, it is true, the social and political causes of this rapid development, but the favorable absence of many topographical conditions, the presence of which might have counteracted them.

The site of the city, on the left bank of the Ohio River, consists of two plains or bottoms, one near the river, comparatively narrow, and composed of argillaceous alluvion; the other in its rear, six or eight times as broad, diluvial, and made up, like the higher or second terraces generally, of pebbles, gravel, and sand, with a covering of loam and soil. The lower plain widens as it stretches down the river, and its back part, on the settlement of the



town, was a narrow, shallow, and heavily-timbered pond or swamp, overflowed by ordinary spring floods of the river, which ascended upon it along the marshy rivulets by which that tract was partially drained into the Ohio, below the town. In 1798 the whole of the lower plain was submerged; and in 1882 and 1848 the inundation was repeated, upon every part which had not been raised, with materials washed by the rains, or hauled from the adjacent higher terrace. For many years after the settlement of the village, the drainage of both terraces was into the low grounds of this bottom, where it accumulated in part upon the surface, and partly in the numerous pits, formed by the manufacture of brick. From these foul accumulations, in summer and early autumn, a constant escape of gas through the superincumbent water could be perceived. The extent of this tract, lying to the west or windward of the village, was sufficient to generate a great many cases of autumnal fever, chiefly of the remittent type, not a few of which every year proved fatal.\* Had its surface been but a few feet lower, so that it could not have been reclaimed, the nuisances in which it abounded must have exerted a retarding influence on the progress of the city. But for the last twenty years the work of transformation by draining, filling up, and building over, has been steadily advancing, and with it a corresponding improvement of autumnal health.

From the lower plain to the upper and older, the ascent is between fifty and sixty feet. With the growth of the town, the front margin of the latter, which was originally a bluff bank, has been graded to a gentle declivity, and the removed material used, as already intimated, to raise the back part of the lower bottom; so that the drainage of the city is now chiefly by the streets directly into the river.

The upper terrace, as was the case with the lower, slopes gently back from its southern or river margin, and, at the average distance of a mile, terminates against the base of the Mount Auburn range of blue Silurian limestone hills; whence, during rains, there descend upon it several torrents, which coalesce and flow nearly in the same direction with the river. To the east this terrace is terminated by the narrow valley of a hill-torrent, called Deer Creek. Up this valley, in early times, the back-water of the river, when in flood, ascended for half a mile; and on its recess left a deposit of silt, which, however, was to the summer-leeward of the town, and therefore never produced much effect on the health of the people. Beyond this ravine stands Mount Adams, between the base of which and the eastern margin of the city terrace the low ground has been raised above the highest river floods, a culvert has been formed for the creek, with streets extended across it, and the new surface built upon. The ravine, higher up, has a rocky bed and no bottom-lands.

The Western Canal, from Lake Erie, generally called the Miami Canal, traverses the back part of the upper terrace, from north-west to south-east,

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\* Drake: Notices concerning Cincinnati, 1810.



and descends into the Ohio by a series of locks through this valley, but does not seem to have generated fever.

We must now turn to the western margin of the terraces. In stretching off in that direction down the river, both become wider and sink lower, until they are lost in the broad alluvial valley of Mill Creek, which stream, once a great river, joins the Ohio one mile and a half below the center of the city. Its banks are of mud, and portions of them are overflowed by river freshets. The work of elevation, by the transfer of gravel and pebbles from the upper terrace, is, however, going on with the rapid extension of the city in that direction; so that the time seems to be at hand when the whole tract will be redeemed from all but the extraordinary floods which happen at distant periods, and of which there have been but three since the first settlement of the city. From that date down to the present time, the inhabitants of this locality have been subject to autumnal fever, while those farther east remained exempt.

The Whitewater Canal, from Indiana, which is conducted up the river bank, crosses Mill Creek by an aqueduct, and traversing the lower terrace, terminates in a basin of stagnant water in the south-western part of the city, contributing, no doubt, to the prevalence of fever in that quarter.

The river shore, from the mouth of Deer Creek to the mouth of Mill Creek, a distance of two miles and a half, presents but few nuisances. At the former point the stream has thrown out a quantity of silt, which, in low water, is laid bare to a limited extent; from that spot to the other, the shore is free from natural sources of insalubrity, much of it being sloped and graveled down to low water. In front of the mouth of Mill Creek there is a deposit of silt, enveloping the trunks and limbs of trees, of which a considerable extent is exposed in summer and autumn, and, lying to the windward of the city, may be regarded as the most permanent nuisance around it. Below the *embouchure* of Mill Creek, for two miles, and above that of Deer Creek for four miles, there is no alluvial bottom, and the river presses against the base of the limestone hills.

We must now cross the Ohio, and speak of the towns of Newport and Covington, as promised when treating of the Licking River Basin. The mouth of that river is nearly opposite the center of Cincinnati. Above it stands the old but slow-growing town of Newport; below, the young and more vigorous town of Covington. The position of these towns is represented on *Pl. XIII.* The bottom on which the former stands, is ample; and, except a margin of its back part near Licking River, is elevated above the highest floods of the Ohio. Where the plain approaches the hills in its rear, there is some swampy ground, bearing semi-aquatic grasses, which becomes dry in autumn. The Newport bottom extends up the Ohio three miles, as a dry, elevated, and sloping plain, and has become the site of a new village, JAMESTOWN, opposite the village of Fulton. The Covington terrace, below the mouth of Licking, is still more elevated than that of Newport, and, with the exception of a ravine through its western margin, up which the waters of the Ohio ascend in high floods, is free from every insalubrious

topographical condition. A range of dry hills rises boldly to its south-west, one of which almost touches the Ohio opposite the mouth of Mill Creek, receding immediately afterward, and affording a broad, elevated, and arid bottom, on which another village, supplementary to the city, has been commenced. The bottom-lands of Licking River above these towns, and directly south of them, are about a mile in width, but so elevated, that they are but partially overflowed by river-freshets, which leave behind them very few ponds or marshes. Finally: On the promontory above the mouth of Licking, the general government, since the year 1805, has had an arsenal and barracks; but the number of troops stationed there has generally been small, and no returns have been published in the army statistics.

The prevalence of autumnal fever in Newport and Covington has at all times been in harmony with their topography as here described. In the latter, the number of cases is smaller in proportion to the population than in the former; which is what its topographical condition demands. The cases which occur are chiefly on the border which extends up the valley of Licking. That valley lies to the windward of Newport, and exerts a prejudicial influence on the health of that portion of its people who live nearest to it; but they are never seriously invaded.

Let us now contemplate, as a whole, the locality we have been surveying in detail. *First:* As a general fact, where a tributary enters the Ohio, there is much low bottom; but here, two join it, on opposite sides, and the extent of drowned land is very little. I have elsewhere intimated that Mill Creek, during the diluvial period, was a great river; and then it was, that an immense quantity of drift, in the form of sand, gravel, pebbles, and boulders, was heaped up in this locality to such a height that nearly all the terraces are above the ordinary freshets of the Ohio. *Second:* The area of these terraces, including both sides of the river, is about six square miles; and their extent, taken in connection with their elevation above the river, gives this locality an advantage over every other, from the sources to the mouth of the river. *Third:* As a consequence of this topography, there is no other spot on the banks of the Ohio, where so great a number of persons could reside with as little exposure to the causes of intermittent and remittent fever. *Fourth:* From observations continued through forty-eight years, I am enabled to say, that while, in early times, autumnal fever, occurring every year, was seldom, except in some very limited spots, a violent and frequent disease, it has regularly diminished; and that parts once infested have become exempt. So true is this of the central portions of the city, in latter years, that when a case of intermittent fever happens there, it is generally found that the patient had sojourned in the country. Of remittent fever, so much cannot be said, as occasional cases still appear on streets which are entirely exempt from the other variety. *Fifth:* The estimated population, within a circle having a radius of a mile and a half, is about one hundred and ten thousand; and the extraordinary growth, which has assembled such a number in so short a time, must undoubtedly be ascribed, in part, to the slight prevalence of autumnal fever; by which we are instructed,

that medical topography has an intimate connection with the progress of population and civil improvement.

Cincinnati has extended ( chiefly by a single street ) nearly four miles up the Ohio, with the river close on one side and the hills as close on the other; the bank rising above high water. This extension comprehends the villages of Fulton, Lewistown, and Pondleton. Beyond the last, to the mouth of the Little Miami River, two miles further up, there is a broad, alluvial plain, on which once stood the village of Columbia, the second settlement in the State of Ohio, made November 18th, 1788. Much of this bottom, especially that nearest the Miami, is subject to inundation in the spring of the year, and the inhabitants, chiefly agriculturalists, are subject to autumnal fever; which, however, is much less prevalent and violent than I saw it in 1808, and for many years afterward, when the locality was *in transitu* from dense woods to cultivated fields.

Up the valley of Mill Creek, which is equal in width to that of the Ohio (although in summer there is scarcely the feeblest current of water), autumnal fever is an annual endemo-epidemic. This valley is not without second, and even third, bottoms or terraces, which are elevated and dry; but it has also broad and low alluvions, on which the overflows of the stream and the spring rains leave sloughs filled with the decaying vegetation of its deep and fertile soil. To these surfaces we should ascribe the fever, which, limited to them in its origin, extends far beyond them in its spread; as it frequently reaches, not only those who reside on the older terraces, but, also, the inhabitants of the neighboring bluffs. The malignant intermittents of the south are not, however, often met with in this locality, nor ever have been; and the chief mortality is from the remittent type, in its progress becoming typhous.

The hill-lands around Cincinnati are, in all directions, of the same height and character. In some places there are gently undulating table-lands; but in general the country is rolling, and presents a countless number of knobs or tuberosities, covered with rich soil, resting on a clay or loam bed, embellished with numerous country seats. Permanent springs are scarce, and much of the well-water is of an inferior quality. Ponds, swales, and swamps are, of course, unknown; yet autumnal remittent fever, tending to a continued type, occurs more or less every year, and sometimes proves fatal.

For many years after the first settlement of Cincinnati, the people supplied themselves with water from wells, and, also, from the river, as is still the case in Newport and Covington. But to these methods succeeded the present hydraulic system. The water is thrown by a forcing pump into reservoirs, exposed to the sun and rains, whence it is distributed, through iron and lead pipes, over the city. It often comes to the consumers turbid. The silt which it deposits in the reservoirs, a portion of which, remaining in suspension, is swallowed with the water, no doubt varies considerably in its composition. A single analysis, of a specimen thrown out of the reservoir in the spring of the year, was made, at my request, by Doctor Raymond, and gave the following results in one hundred parts:



Alumina, - - - - -	40.84
Silex, - - - - -	88.80
Carbonate of lime, - - - - -	2.00
Do. Iron, - - - - -	1.15
Phosphates of alumina and iron, - - - - -	0.52
Carbonate of magnesia, a trace, - - - - -	0.00
Vegetable mold (humus), - - - - -	8.50
Other organic matter, - - - - -	4.00
	<u>100.00</u>

In general, during every flood, the water when distributed is turbid.

For a long time after the settlement of Cincinnati, its only fuel was wood; but this, to a great extent, has been superseded by bituminous coal, from the Appalachian Basin. At present, the amount consumed is greater than in any other locality in the Interior Valley, save Pittsburgh. This results, not merely from the great number of inhabitants, but also from the multiplication of their manufacturing establishments; some of which will come under review when referring to the causes of other diseases than autumnal fever. From the better ventilation of this locality, its atmosphere is, however, much less laden with the fumes of burning coal, than that of Pittsburgh. The natural facilities for this ventilation may be seen by referring to the map.

Cincinnati stands in Lat.  $39^{\circ} 6' N.$ , and Long.  $84^{\circ} 20' 30'' W.$  The elevation of the surface of the river, at low water, above the level of the sea, is four hundred and thirty-one feet; that of the lower plain about four hundred and ninety; that of the upper, five hundred and forty-three; that of the surrounding hills, on an average, not far from eight hundred and fifty feet.

The population of the city presents many varieties of physiology. The original settlers were from various states of the Union; and the armies of Harmer, St. Clair, and Wayne, during the Indian wars, left behind them a still greater variety of persons. The subsequent immigration, although largely from the Middle and Northern Atlantic States, has been, in part, from the more Southern. In latter years it has been composed, still more than from either, of Europeans. The most numerous of these are Germans, next Irish, then English, Welsh, and Scotch. Very few French, Italians, or Spaniards have sought it out. Lastly, its African population, chiefly emancipated slaves and their offspring, from Kentucky and Virginia, is large; and although intermarriages with the whites are unknown, the streets present as many mulatto, griffe, and quadroon complexions, as those of New Orleans. Thus the varieties of national physiology are very great.

## SECTION VII.

## NORTHERN BANKS AND HILLS OF THE OHIO RIVER, FROM THE GREAT MIAMI TO THE WABASH.

I. GENERAL CHARACTERISTICS.—It is a remarkable feature in the tributary-hydrography of the middle section of the Ohio, on its northern side, that from the Great Miami to the Wabash, a distance of three hundred and seventy-five miles, there is not a single affluent which deserves the title of river,—not one that is more than a wet-weather hill-torrent, insufficient even for mill purposes, except in rainy seasons. In fact, at distances, varying from ten to thirty miles, back from the Ohio, the streams flow off to the north, and have their confluence in the East Fork of White River, which, uniting with the West Fork, pours its waters into the Wabash.

Here, then, is a long, narrow, serpentine zone, deeply cut by rivulets, which, descending to the south, enter the Ohio through its broad bottoms, or by other streams which flow to the north, in excavations which are less profound. Such a tract cannot abound in swamps or ponds, and the water-courses present but few wide alluvial bottoms. As a general fact, they sink to the level of the Ohio before reaching it; and, therefore, near their mouths, become, in all its floods, receptacles of back-water, which on receding, leaves deposits of mud and drift-wood, which the subsequent rains generally wash out into the river. When, however, there is a June flood in the Ohio, the silt is apt to remain through the subsequent dry season, and prove a source of insalubrity. Hence, those who live near these foul estuaries, which mingle their influence with that of the river-bottoms, experience intermittent and remittent fevers, notwithstanding they are in the midst of a hilly country. In traveling on this zone from its upper to its lower extremity, we start upon the blue shell or old Silurian limestone; then meet, resting on it, with the upper or cliff Silurian; then with the Devonian limestone, supporting the black slate, on which rests the fine-grained sandstone of the same group; after which, we meet with the carboniferous limestone, and the higher strata within the Illinois coal basin. All these formations crop out to the east or south-east, from beneath that basin. Of course the mineralogical character of the surface, composed as it is of the *debris* of these different formations, intermingled with forest and herbaceous remains, varies according to the mineral constitution of the rocks; and a similar remark is applicable to the water of the springs and wells. The whole tract is wooded, the trees varying in their species with the varieties of soil. The mean elevation of the zone may be taken at eight hundred feet, but the highest swells attain the altitude of one thousand feet. We must now say something of the most important localities.

II. LAWRENCEBURG stands a mile below the mouth of the Great Miami, in the State of Indiana; the dividing line between that state and Ohio, being the meridian of the mouth of that river. Its site is a bottom, so low that all parts not artificially raised, are subject to annual inundation. Above the town, to its east and north-east, are the wide, low, and annually inundated

bottoms, on each side of the estuary of the Miami, well known to generate autumnal fever; but as they lie to the leeward of the town, their pernicious influence, in summer and autumn, is much less than it would otherwise be. Yet, doubtless, they contribute something to that prevalence of intermittent and remittent fever which is partly to be ascribed to the inundation of the greater part of the plain, on the front of which the town is erected, and partly to a valley-stream in its rear, called Tanner's Creek, up which the back-water in river-floods makes its way almost round the town. The main street, since it was raised, is four hundred and seventy-three feet above the sea—the hills at the sources of Tanner's Creek ten hundred and thirteen feet.\* In the early period of the settlement of Lawrenceburg, these fevers were extremely prevalent; but at present are so mitigated in frequency and violence, as to show very conclusively the influence of cultivation and town-construction, in destroying the topographical condition on which they depend. Within a few years, a branch of the Whitewater Canal has been brought through the town, but of its influence on autumnal health I cannot speak.

Passing by Aurora, Rising Sun, and some other villages (for all cannot be noticed), we must devote a page to a larger and more important town than either.

III. MADISON. — This town, one of the oldest and most considerable in the State of Indiana, is situated on a diluvial and dry second bottom of the Ohio River, but has, in front of its lower half, a narrow strip of alluvion which is subject to occasional inundation. The upper terrace is elevated about four hundred and seventy-five feet above the sea. Its breadth is not very great, for an amphitheater of Silurian limestone hills, rising four hundred feet higher, closely surrounds it. The back part of the terrace declines a little, and is somewhat cut up by ravines, which run into a common trough called Crooked Creek, in which the torrents from the adjoining hills sometimes congregate so as to occasion a considerable inundation. This stream enters the Ohio two miles below the town, behind which it conducts the back-water of the river in every great freshet. The banks, however, are high, and, on the whole, the plain is not infested with any form of drowned lands; the shore, in front of the town, is free from nuisances; and the opposite hills of Kentucky approach close to the river, whose course to the south-west, on leaving the town, favors ventilation by the summer winds, which, in reaching it, do not pass over any paludal surface. Such a topography must admit of a favorable report, as to autumnal fever; which, in fact, prevails here but to a limited degree.

IV. JEFFERSONVILLE. — The position of this town may be seen on *Pl. XI, Ch. IX, Sect. VII.* It stands about a mile above the Falls of the Ohio, on a terrace, the south or river side of which is forty feet above low water, and about four hundred and twenty above the sea. This terrace, like most others along the Ohio, declines from near the river, and is liable to inundations, so that in high floods the town becomes insulated. Both above and below it

\* Indiana Engineers' Reports.



there are small streams entering the Ohio, which are the channels by which these overflows are effected. To the north and north-east, near the town, there are ponds skirted with marsh, one of which has been lately drained. The surface, like that of the plain on which Louisville stands, on the opposite side of the river, is argillaceous, and retains the water which rains or flows upon it. It will be observed that all the insalubrious surface lies to the summer-leeward of the town; but the flats and stagnant waters near the mouth of Bear-grass Creek, on the opposite side of the Ohio, are directly to the windward of this town, with only the river intervening. Jeffersonville is also to the leeward of the Falls, and exposed therefore to any insalubrious gases which may be liberated by the agitation of the waters. Two miles north of the town, a water-shed, between the Ohio River and Silver Creek, commences and runs to Charleston, thirteen miles north. At its commencement this terrace is sixty feet above the level of the town, and its rise, afterward, is about ten feet per mile. Doctor Stewart, to whom I am indebted for several of the facts in this article, informs me that autumnal intermittents and remittents are decidedly prevalent in Jeffersonville and its vicinity.

The Penitentiary of the State of Indiana stands in the western part of Jeffersonville. Doctor Collum, its physician, informs me that the convicts are every year invaded by autumnal fever, but in a degree rather less than the inhabitants of the town.

V. NEW ALBANY. — The position of this town is below the Falls, nearly opposite Portland (*Pl. XI*). Silver Creek enters the river between New Albany and Jeffersonville, which are about six miles apart. Of this stream, Doctor Clapp (by whom I have been favored with facts for this description) says, "it presents no ponds or marshes, within ten miles of New Albany, except mill-ponds, and they cause but little overflow of the surface." As to the town-site, a narrow slip near the river, not very much built upon, it has been entirely overflowed but twice in thirty years. The upper terrace is fifteen feet above the highest freshets, and four hundred and twenty-six above the sea. Immediately to its west is a small stream called Falling Run, up which the back-water of the river ascends a short distance; and about once in four or five years overflows a few acres. The bed of this stream is rocky, and its descent rapid. It flows at the base of the bold rampart called Silver Creek hills, which rises to an altitude of nine hundred feet over the sea, and four hundred and eighty above the terrace on which the town is built. This terrace consists of a bed of alluvion, thirty feet deep, resting on black or Devonian slate, which emerges from underneath the hills.

Of all the towns around the Falls, New Albany is the least exposed to the topographical causes of autumnal fever; and from the best data I have been able to collect, it suffers least. From 1817 to 1822, the first five years of Doctor Clapp's residence in it, those fevers prevailed extensively, but have ever since been diminishing.

VI. THE BLACK-SLATE VALLEY-PLAIN. — A description of that portion of this plain which lies south of the Ohio River, was given in *Sect. VII* of

the last Chapter. p. 246. Its extension to the north side of the Falls has been announced, in speaking of the substrata on which the alluvial or diluvial terraces of New Albany and Jeffersonville rest. It remains to say, that this depression extends northwardly quite into the interior of Indiana. For twenty-three or twenty-four miles, it preserves a width corresponding with that from the mouth of Salt River to the Falls. The hills then approach so near to each other, that the plain becomes an isthmus, and has received the name of Collins' Gap. It afterward expands; but to trace it further would carry us too far beyond the limits of this Section. The approximate hills have an altitude, on the eastern side, of one hundred and seventy feet; on the western, of five hundred feet. The former are composed of the upper Silurian limestone, which has emerged from beneath the black slate; the latter of the sandstone which, farther west, overlays that formation. The disintegration of the slate, I may repeat, has produced this remarkable valley; the surface of which is nearly five hundred feet below the general level of the country. Its principal stream, on the north side of the Ohio, is Silver Creek. When the French traveler, Volney,\* visited the Falls, in 1776, his attention was strongly turned to this depression, which, he conjectured, was the bed of a drained lake; a theory which is sustained by the undulating deposits, and, what Doctor McMurtrie† calls 'planispherical accumulations' of sand, which in various places rest on the argillaceous *debris* of the slate formation; a bottom which is almost water-tight, and has, consequently, given origin to the ponds and swamps which have rendered the whole tract unhealthy, in autumn, from the earliest period of its settlement. When the surface shall be completely drained and cultivated, the health of the inhabitants will undergo a great amelioration.

VI. EVANSVILLE, the commercial metropolis of south-west Indiana, stands a little below the thirty-eighth degree of north latitude, not far above the mouth of the Wabash River, and almost beyond the southern extremity of the hill-zone described in No. I. of this Section. I am indebted to Doctor Walker for the following account:

"The plain on which the town is built has an elevation of about three hundred and seventy-two feet above the sea, and ten or twelve over the highest floods of the Ohio. It is situated on the extreme convexity of a short bend made by the Ohio, which, after having flowed many miles to the north-west, turns suddenly and sharply to the south-west, and then to the south-east, whence, making a *detour* round to the west, north-west, and even north, it resumes its general course and flows off to the west. A sluggish bayou, beginning a short distance below the town, constitutes the chord of this great segment, or rather, completes a rude circle, which incloses fifteen or sixteen square miles of low bottom, fertile, subject to inundation, and lying to the south-west or summer-windward of the town. The bayou itself is foul, and has low grounds on both its sides. As the river approaches the town it

\* View of the Soil and Climate of the United States: 1804, Philad.

† Sketches of Louisville. By H. McMurtrie, 1819.

divides into two channels, inclosing a long depressed island. The channel, which lies on the same side of the river with the town, and which reunites with the other but a short distance above it, is too shallow and obstructed for low-water navigation, and becomes foul in summer. Opposite the town, on the Kentucky side, there is an extensive bottom, which is liable to frequent inundations. The river-bottoms, commencing a mile below and half a mile above the town, are liable to submersions every four or five years, and are not destitute of ponds and sloughs. The terrace on which the town is built, stretches off to the north for many miles; a sufficient evidence that, in reaching this locality, we have nearly escaped from the zone of hill-country described in *No. 4*, of this Section. A mill-stream, called Pigeon Creek, traverses this valley, passes near the rear of the town, and joins the Ohio a short distance below. Its banks are generally so high, that neither its own floods nor the back-waters of the Ohio overflow them to much extent.

The surrounding uplands rise from one to two hundred feet above the town-site, and present many tracts of table-land, abounding in swales and marshes.

This locality, both in town and country, but much more in the latter than the former, is subject to autumnal fevers, which often assume a malignant and fatal character. Many topical affections, moreover, such as neuralgias, assume a periodical character, and afford additional evidence of autumnal insubriety.

With these notices we dismiss the river-zone, and travel into the interior. The region which must first receive attention, lies in the rear of that which has been described, and is comprehended in a small hydrographical basin. I shall treat it in the briefest manner.

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## SECTION VIII.

### BASIN OF WHITE RIVER.

I. GENERAL HYDROGRAPHY.—White River is the largest tributary, and almost a coequal, of the Wabash, which it joins about one hundred and ten miles from the junction of the latter (following its meanders) with the Ohio. On the north it is surrounded by the Wabash; on the east its sources mingle with those of the tributaries of the Great Miami; on the south, it receives the water of streams which originate on the northern slopes of the hill-zone which has just been described. White River is composed of two great branches, called the East and West Forks, the former of which flows nearly parallel with the Ohio, while the latter pursues a more southerly course, until they unite not many miles above the junction of their common trunk with the Wabash. Nearly a third part of the State of Indiana—its southern and south-eastern—is comprehended in this basin, the eastern portion of which rests on Silurian limestone, while the western lies within



the great Illinois coal formation. Thus, its surface-rock is, in some parts, calcareous, in others, arenaceous, in others, schistose or argillaceous.

II. THE EAST FORK.—That division of the basin which is drained by the East Fork, is, in reference to its surface, a continuation of the lower or southern part of the Miami Basin; that is, it presents rounded wooded hills, not formed by elevation above the general surface of the country, but by valleys and ravines of excavation; some of which have bottom-lands of considerable width, but, on the whole, narrow alluvions, more like those on the south than the north side of the Ohio River. The body and basis of these hills is the limestone already mentioned. In passing westwardly we leave this limestone, not to meet with it again in the Ohio Basin, and come to the Devonian slate, which stretches, northwardly from the Falls of Ohio, in a belt of more level land, with a more poney and swampy surface; to this succeeds—still going to the west—the rugged eastern margin of the coal formation, which, however, becomes more flat after we have passed the out-crop of sandstone which underlies the coal measures, and their associate shales, sandstones, and carboniferous limestones.

Every part of the region drained by the East Fork of White River, is subject to autumnal fever, which is more frequent and severe in the neighborhood of the river and its larger tributaries, than upon the uplands.

III. THE WEST FORK—more correctly the north—is a longer stream than the East, running nearly south south-west, through two degrees of latitude, but not draining a greater surface. The region from which it flows is more level than the last, embraces many prairies, both wet and dry, and presents along its streams much wide bottom-lands, with more of northern drift or transported materials on its surface. Thus, it is a continuation of the upper part of the Miami Basin. Its autumnal fevers are essentially the same as those of the East Fork.

IV. INDIANAPOLIS, the capital of the State of Indiana, stands on the left or east bank of the West Fork of White River, in N. Lat.  $39^{\circ} 55'$ , and W. Long.  $86^{\circ} 5'$ . The plain which constitutes its site is slightly undulating, with an average elevation of twenty feet above low-water mark, and about seven hundred above the level of the sea.\* The principal part of the town is three quarters of a mile from the river. At a short distance above and to the north of the town, Fall Creek enters the river, which it reaches from the north-east. A smaller stream passes through the suburbs of the town, on the east and south sides, to join the river below. In summer and autumn this stream nearly dries up. Immediately north, there was formerly a pond, which discharged its superfluous waters across the town-plot; but a ditch has been made to drain it into Fall Creek. East of the town, at the distance of a mile, is the margin of a slightly rolling tract of argillaceous ground, covered with beech timber. To the north, the country is a little broken; but we have there the wide alluvial bottoms of White River and Fall Creek. West of the river, the bottom is a mile in width, and so low as

\* Indiana Engineers' Reports.

to be overflowed in all high freshets. At the foot of the bluffs which terminate this bottom, there is a swale, or pondy belt, from ten to forty rods wide, overshadowed with trees and rank grass, or rendered foul with drift-wood and other organic matters, thrown into it by the river floods. Its length is about two miles. Beyond this, to the west and north-west, for several miles, there is a dry, old terrace of sand, gravel, and other northern drift, bounded by Eagle Creek. On one of the undulations of this plain, stands the Lunatic Asylum of Indiana.\* On the terrace east of the river, between it and the town, there is a canal, designed merely for hydraulic purposes, with a lock through which the water is restored to the river. Every summer it becomes choked up with a luxuriant aquatic vegetation, which is destroyed by letting out the water in July or August.

Doctor S. G. Mitchell† informs me that, on digging wells in the town, they first pass through four or five feet of soil and loam, then through fifteen or twenty feet of gravel, and afterward continue in white sand, as low down as perforations had been made. The same early medical historian of Indianapolis tells us, that the settlement of the town was commenced in 1820, when the plain was heavily timbered with various kinds of trees. In the spring of 1821, these were extensively cut down, and immigrants crowded upon the spot, until, by midsummer, they numbered about six hundred. They were miserably lodged in open cabins, shanties, and even tents; and subsisted largely on fish and game, with very little salt. July and August were unusually hot and wet. Every thing molded. The luxuriant foliage of the fallen trees and trodden-down annual plants, underwent a rapid decomposition. Exhalations offensive to the smell arose. Many domestic animals died, and, in the latter part of July, intermittent and remittent fevers appeared. They commenced near the river, and extended eastwardly through the new village, assuming a malignant character. Before the epidemic closed in October, nearly every person had been more or less indisposed, and seventy-two, or about an eighth part of the population, had died. Many of the most malignant or algid cases commenced as simple intermittents. Since that time, Indianapolis has not experienced a severe visitation; but its vicinity, especially to the north, remains, as its medical topography would lead us to expect, subject to annual invasions.

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## SECTION IX.

### basin of the Wabash.

I. GENERAL SURVEY.—Although White River is a branch of the Wabash, its size and slight connection with that river, made it convenient to describe it under a separate head. The basin of the Wabash above the mouth of its great affluent, is long, narrow, and curved round from south-

† Doctor John Evans. MS. *penes me.*

‡ Western Journal (Cincinnati), Vol. 11, p. 413.

west to north-east. The mouth of the Wabash is found in N. Lat.  $37^{\circ} 47'$ , and W. Lon.  $87^{\circ} 45'$ ; its most northern sources in Lat.  $41^{\circ} 15'$ , and its most eastern in Lon.  $84^{\circ} 30'$ . Originating in the western part of the State of Ohio, it traverses Indiana diagonally, and joins the Ohio River between that state and Illinois, not far below Evansville. Its upper waters originate in ponds or small lakes, and extensive marsh-prairies, on the summit-level between the Ohio Basin, and the basins of Lakes Michigan and Erie. Eminently an alluvial river, it everywhere has wide bottom-lands, many of which are subject to spring and early summer inundations, leaving behind them ponds, bayous, marshes, and swales, abounding in drift-wood, and other foul deposits. The fertility of these bottoms is great, and their vegetation luxuriant. All the upper portions of the Wabash Basin are overspread with extensive terraces or plains of clay, sand, gravel, pebbles, and other transported materials from the north, which bury up the rocky strata.\* In the lower or southern portions of the valley, which are moderately broken, the amount of drift is much less, though it is abundant in the wide trough of the Wabash. It need scarcely be added, that such a region as has been thus comprehensively sketched, having an altitude not exceeding seven or eight hundred feet for its summits, while the bottom-lands of its streams are considerably lower, is liable to autumnal fever. That disease, in fact, prevails in every portion of it. But I must not dismiss it without giving an account of some of its more important localities.

II. LAFAYETTE.—I have received from Doctor Deming the materials for a descriptive notice of this locality. The town stands on the left-hand bank of an eastern bend of the Wabash, in Lat.  $40^{\circ} 18'$ , at a height of five hundred and thirty-eight feet above the level of the sea, and thirty-five feet above low water; an elevation which protects it from inundation. The upper strata of this terrace consist of sand and gravel, resting on a stratum of hard blue clay, in some places fifteen feet thick, which has to be passed through to obtain good well-water. Below this deposit, and in the hills, there are strata of sub-carboniferous limestone. The surface of the terrace is sufficiently undulating to favor draining. In the southern part of the town-plot there are a number of small streams, fed by springs, and there were formerly several acres of boggy marsh, which have been drained and put under cultivation. With the exception of this spot, there were no swamps or ponds near the town, on the east side of the river. In receding from the river to the east, an old or second bottom is encountered, the bluff margin of which has been sloped so as to present a gradual rise. The hill-land rises on the south side of the town to the height of eighty feet—on the east, to one hundred and seventy feet—on the north-east, to one hundred and fifty. This semi-circle of highland is covered with timber, beyond which, eastwardly, lies the Wild-cat Prairie; portions of which were swampy, but have been reclaimed, with a consequent great amelioration of autumnal health. Opposite the town, on the western side of the river, a low bottom, commen-

\* Doctor Owen's Second Geological Report.



ing a mile above, extends several miles below. It is annually inundated, sometimes to the depth of fourteen feet, and Doctor Deming has noticed, that its occasional summer-inundations are far more productive of fever than those of spring. The width of this bottom varies from a quarter of a mile to a mile. Lying to the summer-windward, this bottom, with the wet and swaley tract on the south side of the town, is no doubt the principal cause of the decided prevalence of autumnal fever, which annually occurs at this place. According to Doctor Deming, a large proportion of its diseases are intermittent and remittent fevers; many cases of the former, called by the people, 'sinking chills,' are decidedly malignant. So great, indeed, is the paludal influence, that almost all forms of disease, especially pneumonia, dysentery, and epidemic erysipelas, manifest its effects.

III. TERRE HAUTE.—I have been favored by Doctor Read and Doctor Cloppinger, with facts for an account of this locality. The latitude of Terre Haute is about  $39^{\circ} 24'$  N. Its elevation above the level of the sea, is four hundred and eighty-three feet—above high-water mark of the Wabash, twenty-five feet. At the distance of three miles east from the river, there is another terrace about fifty feet higher. The town stands on the left or eastern side of the river, and occupies a portion of the western margin of the plain just mentioned, which is known as the Fort Harrison Prairie. This terrace, which, from its elevation, suggested the name by which the town is known, extends several miles up and down the river. It belongs to the diluvial epoch, and rests upon the coal measures. According to Doctor Read, in sinking wells into it, they pass through soil, and then white sand, with occasional layers of gravel, to the average depth of fifty-five feet (which is beneath low-water mark of the Wabash), when abundance of clear, cold, hard water is found, in a broad sheet or stream, making its way through the sand to the south-west, in the general course of the river. According to the same authority, there is, at the distance of half a mile east of the town, a depression of the terrace, to the extent of several thousand acres. Its length is parallel to the river, and it formerly received water from the higher ground, during rains, and was left with a swaley surface. That which flowed into it was, however, at length turned to the river, and the whole reclaimed and cultivated, with a favorable influence on the health of the inhabitants. Doctor Cloppinger did not observe that this swampy tract exerted any injurious effect on the health of the town, which lies to its west or windward; but the people who reside north of it suffered severely. On the opposite or western side of the river, there is a low, wide, heavily-timbered, alluvial bottom; which is, every spring and summer, deeply inundated, giving to the river in high floods the width of a mile. These floods leave the surface wet and foul; and in the middle of the bottom, half a mile west of the river, there is a permanent swamp of about twenty acres, between which and the town, there stands, however, a thick wood, which is supposed to exert a protecting influence.

Both the gentlemen whom I have quoted, testify to the great prevalence of autumnal fever in this locality, where all the varieties, from the most simple up to the most malignant, are met with. In summer and autumn *all* diseases, according to Doctor Reed, tend to periodicity, and, in winter, pneumonia is so greatly modified by the paludal influence, that bloodletting is sometimes followed by death. Both these physicians, moreover, testify to the fact, that persons living near the margins, and almost on the level of the paludal tracts, are less subject to autumnal fever than those who reside at the distance of a half a mile or a mile, and at a higher elevation. In support of this statement, Doctor Clappinger has made a number of specifications, which I have not space to transcribe, and concludes by informing me, that Doctor Patrick, an old and intelligent physician, long resident at Terre Haute, has observed all that is here recorded.

IV. VINCENNES. — The site of this town, an old French village, settled more than a century since, is a beautiful diluvial prairie, from one to two miles in width, extending six miles along the Wabash River, on its left or eastern side. Most of the plain is sandy. The spot on which the town is built is not subject to inundations, but immediately below, and for three miles down, the bottom, before it was protected by a levee, was liable to submersion. About a mile and a half east of the town, there were several ponds and marshes, which, however, have been drained into the river, five miles below. Beyond these ponds there are bluffs, followed by clayey table-land. On the west, or right-hand side of the river, there is a belt of low timbered bottom-land, a mile in width, succeeded by a prairie six miles wide, and of much greater length up and down the river, which, in high floods, is more or less subject to inundations, that leave ponds and marshes behind them. Such is the broad valley of the Wabash at this point. The elevation of its high or diluvial bottom-lands is about four hundred and fifty feet above the sea. The latitude of the town is  $38^{\circ} 43' N.$ , its longitude  $87^{\circ} 25' W.$  Its population is two thousand five hundred, one-third of whom are descendants of the original French settlers.

The inhabitants of the prairie on the west side of the river, are subject, in a decided degree, to remittent and intermittent fevers; those on the eastern side are afflicted rather less, as to the number of cases, but more severely in degree. In latter years, malignant cases, late in autumn, have not been uncommon.\*

V. NEW HARMONY. — This is the settlement made by Mr. Robert Owen, of Scotland, in the year 1824. Its latitude is  $38^{\circ} 11' N.$ , its longitude  $87^{\circ} 35' W.$  It stands on the left or south-eastern bank of the Wabash river, near a quarter of a mile from its margin, and about half a mile from a higher terrace in its rear. "The bottom on which the town is built," says Doctor Murphy, "is considerably more elevated than the slip between it and the river. The whole bottom, from the river to the highest terrace, is about a mile wide, increases gradually in width, as we ascend the river, and is under

\* Doctor Joseph Sommer, MS. *penes me.*

cultivation. The level of the town site is about six feet above the highest floods of the river, and near four hundred feet above the Gulf of Mexico. The soil consists of rich vegetable mold, with a liberal admixture of sand, in consequence of which it dries rapidly after rain. The only standing water near the town is a brick-pond, to its south, which is sixty yards in diameter, and nearly dries up in summer. The water used by the inhabitants is from wells, which receive it by percolation from the Wabash, and, therefore, it is soft. To the north-west of the town is the river, the width of which is nearly a quarter of a mile. Half a mile below the center of the town the Harmony cut-off issues from the river, to join it three miles below; by which, from the circuitous course of the river, an alluvial island, fifteen miles in circumference, is formed to the west of the town. The whole of this surface is overflowed by river freshets, and ponds and sluices are left behind, but none of them lie near the town. It is covered by a dense forest, with luxuriant herbaceous vegetation, and none of it is under cultivation. Opposite the town is Fox Island, on the western side of which a portion of the Wabash flows, whenever it rises to a mean high. This island is covered with forest trees and a canoe-brake, and presents ponds and bayous, none of which, however, are near the town. It only remains to add, that to the south of the town there is a range of hills, and that the terrace on which the town is built stretches off some distance to the east, and is under high cultivation."

It is, I suppose, generally known, that in prosecuting his great experiment on the community-system, Mr. Owen assembled around him, on this spot, a number of distinguished *savans*, who knew much more of the physical than of the moral world. Both the cultivators of science and of the soil were long since dispersed; and a common American town, with eight hundred inhabitants, now occupies ground consecrated to the new social system. They are subject to the fevers of autumn, which often display a malignant character, like those of the towns higher up the river.

VI. VALLEY OF THE WABASH BELOW NEW HARMONY.—From New Harmony to the junction of the Wabash with the Ohio River, the distance is fifty-five miles. According to Doctor Murphy, the valley is in general from three to five miles wide; and there are but few spots in the whole distance which are not overflowed by the freshets of the river, to a depth varying from three to ten feet, until we approach the Ohio, when, from the back-water of that river, the inundation is often much deeper. These overflows often take place in summer, but do not seem to be the cause of insalubrity; on the contrary, dry and hot summers are the most unhealthy. On the other hand, Doctor Murphy has observed, that persons living off the river-bottoms and bluffs, on the uplands, are more sickly in wet summers than dry. In comparing the inhabitants in and near the valley with those who reside beyond its influence, he has found the health and longevity of the latter superior to those of the former. He has everywhere observed autumnal fever to be diminished by cultivation. The whole of this region lies in the coal basin.

VII. REGION WEST OF THE WABASH.—In passing the river to the west,



we enter on the vast prairies of Illinois. East of the Wabash they are subordinate to the wood-lands—west, the proportions are reversed. Of this region, a belt, two or three counties wide, extending from the summit-level between the waters of Lake Michigan and the Wabash, belongs to the basin we are now exploring, and is drained by the Embarras and Little Wabash Rivers, not to mention smaller tributaries. The upper beds of these fourteen or fifteen counties, consist almost entirely of diluvial pebbles, gravel, sand, and clay, with a covering of rich vegetable mold. The streams through such loose deposits, of course, have wide bottom-lands, nearly all of which are liable to inundation in times of high water. The surface of this region, whether wooded or woodless, is generally undulating or level, and scarcely anywhere broken into hills and ravines. The rigid grasses of the prairies retard the escape of rains and melted snows, while their long wiry roots bind the soil, and prevent the waters from excavating tranches through which they might flow off. Thus, extensive tracts of wet or marshy prairie are formed and maintained. Between these (many of which will be rendered dry by ditching, when the population becomes denser), and the low bottoms, which are irreclaimable, the whole of this extensive and fertile portion of the Wabash Basin is infested with autumnal fever, of which many cases assume a malignant and fatal character.\* The mean latitude of this belt is 39° N.;—its elevation from seven to eight hundred feet above the sea.

## SECTION X.

### REMAINDER OF THE OHIO BASIN.

I. GENERAL DESCRIPTION.—Between the mouth of the Wabash and the Mississippi River there lies a range of counties, a notice of which will finish the description of the Ohio Basin. They are drained by Saline, Day, and Cash Creeks; embrace but few prairies; and are generally covered with heavy forests, in the southern parts of which there are cane-brakes, and cypress swamps. The upper or northern counties—Hamilton, Franklin, Williamson, and Gallatin,—have a sandy surface, and abound in carboniferous limestone;—the sandstone which underlies the coal formation appearing here and there. The diluvium which overspreads the country further north, is here much reduced in quantity. The remainder of this district makes a part of the extensive alluvial region through which the Ohio unites itself with the Mississippi, and over which, when those rivers are in flood, their waters spread wide and deep; leaving, when they recede, large ponds and swamps.†

About six miles from the Ohio River, and running parallel with it, is an ancient bed of the Wabash, or of a part of that river. It is now a dense

\* Peck's Gazetteer of Illinois.

† *ibid.*

cypress swamp, impassable, except in two places, and there by causeways. It extends from the Wabash to Saline Creek, eighteen or twenty miles, and when the Ohio River is swollen, a portion of its back-water takes the course of this ancient bed.\*

As the region which has been briefly sketched lies in the mean latitude of thirty-seven degrees, and is elevated only about three hundred and fifty feet above the Gulf of Mexico, it is, of course, infested with dangerous autumnal fevers. We must say something of its principal town.

II. SHAWNEETOWN. — I am indebted to Doctor Roo for the following description of this locality :

"Shawneetown stands ten miles below the mouth of the Wabash, and eight miles above the mouth of Saline Creek. From one to the other, there is a range of fertile, heavily-timbered, sandstone hills, varying in their distance from the Ohio, from half a mile to three miles, or even more. At Shawneetown, they are distant a mile. In the river bottoms in front of these hills, there are a great number of lagoons or bayous. Those above the town are from one to three miles long, and from a hundred yards to a mile in width. Their depth is often considerable. During high water in the river, they all communicate with each other, and pour their waters, behind the town, into the lesser bayous below it. The town itself stands on higher ground than that behind it; but when the Ohio and Wabash are swollen at the same time, its entire site is overflowed. On the south or Kentucky side of the river, the hills opposite the mouth of the Wabash press close upon the shore, but soon recede, and a bottom, like that already described, is developed. Thus, the valley of the Ohio, through this region, is about four miles wide, and not unfrequently the whole of it is under water. The ponds left on the south side have in general muddy banks and sandy bottoms. Their water is clear and cool, and they are overshadowed with cypress trees. To return to the plain on which the town is built, I may state, that in the river bank, there is a conglomerate rock, abounding in sulphuret of iron, which undergoes a rapid decomposition, forming sulphate of iron. The wells of the plain afford different kinds of water, according to their depth; in some it is soft; in the greater number, hard. In digging a well, a mile from the river, near the foot of the hill, after having passed through sand, gravel, loam, blue clay, yellow clay, quick sand, and fine clay, they came to a stratum, four feet thick, of river mud, filled with logs, brush, and leaves, portions of the first being converted into beautiful lignite.

"Shawneetown has always been notorious as a 'sickly place.' In the year 1838, the State of Illinois employed a large number of laborers here, on the construction of a railroad. It was a sickly year; the town suffered dreadfully, and the operatives, who were strangers, still worse. A seventh part of them died, and nearly all were sick. But they dug an immense ditch, forty feet in depth, near the river, and deep enough generally to drain all the swamps and ponds in the vicinity of the town. The effect of this

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\* Doctor Roo.

measure on the autumnal health of the inhabitants was instantaneous, and has continued ever since. The fevers of that season no longer return; and when we have an occasional intermittent, it is generally in the spring. Nevertheless, a malignant case, called by the people a congestive chill, is now and then met with. Our worst disease is pneumonia, which will not bear the lancet, and often requires the sulphate of quinine. The fever still continues to prevail on the opposite side of the Ohio, where the swamps have not been drained."

III. CONCLUSION.—We have now finished the topographical survey of the Ohio Basin. If the reader has found it tedious, he should recollect its great superficies; extending from the sources of the southern tributaries of the Tennessee River, in Georgia and Alabama, to those of the Alleghany, in New York; and from the banks of the Mississippi River, in Illinois and Kentucky, to the Blue Ridge in Virginia. He should also remember its diversified geological constitution, from the tertiary deposits to the oldest Silurian or transition limestone. Still further he should meditate on the vast varieties of surface, necessarily presented by such a diversified geology. He should not forget the difference in altitude—nearly two thousand feet—between the alluvial bottoms of the Ohio, where it unites with the Mississippi, and the crests of the Appalachian Mountains, from which its rivulets descend. Finally, he should realize, that this great and fertile basin is, and ever must be, the most populous and important portion of the Interior Valley of North America; and thus he will be prepared to admit, that if there be, to the physician, any utility in this kind of study, any value in medical topography, geography, and geology, the time devoted to the Ohio Basin has not been misspent, nor the space allowed it greater than was demanded.



## CHAPTER XI.

## THE SOUTHERN BASIN, CONTINUED.

## REGIONS EAST OF THE MISSISSIPPI RIVER, AND NORTH OF THE OHIO BASIN.

## SECTION I.

## GENERAL VIEWS.

THE remainder of the Southern or Mexican Basin consists of a long, narrow belt, bounded, on the west, by the Mississippi, above the mouth of the Ohio; on the south-east, by the basin of the latter river; on the north-east, by the basin of the lakes; and, on the north, by the Hudson Basin. In length, the region on which we have now entered extends through ten degrees of latitude, that is, from the thirty-seventh to the forty-seventh. For the first five or six degrees its axis is directly north, when it turns to the north north-east, until it terminates at the interlocking sources of the Mississippi, the River Winnipeg, and the St. Louis of Lake Superior. The average breadth of this long region is about two and half degrees of longitude. As its rivers, all tributary to the Mississippi, traverse it either obliquely or at right angles to its axis, they are, of course, short. The general aspect of the country which they drain is rolling, in some places flat, in none, except near the larger streams, hilly. Prairies abound in all parts. In fact, this is the great prairie-region of the eastern half of the Interior Valley. The lower, or southern third-part, lies within the Illinois coal formation, to which succeeds, in going north, the out-crop of older rocks to the primitive strata near the sources of the Mississippi. As to altitude above the sea, the southern part is lowest, rising, in general, from seven to eight hundred feet only, while, by a gradual increase of elevation, the northern extremity attains the height of fifteen or eighteen hundred. The southern half lies in the State of Illinois, the northern, in Wisconsin. Large portions of this region are, as yet, either thinly peopled or quite unsettled, and hence a minute description would neither be practicable nor of much interest to the medical etiologist.

## SECTION II.

## BASIN OF THE KASKASKIA RIVER.

The Kaskaskia River joins the Mississippi one hundred miles above the mouth of the Ohio. Between the Ohio and the Kaskaskia, much of the country is somewhat broken, and abounds in forest more than prairie. The only stream worth notice is Big Muddy River, which presents abrupt wooded bluffs, with narrower bottom-lands than most of the rivers described in the last chapter.

The general course of Kaskaskia River is to the south-west. Its sources, and nearly all its tributaries, interlock with those of the Wabash, to the south-east, and the Illinois River to the north-west. Of the rivers which belong exclusively to the State of Illinois, this is the longest. The lower half of its basin abounds in wood-lands more than prairies; but in the upper half, the proportions are reversed, and the forest is chiefly found in the neighborhood of the streams. The former division, moreover, is dryer and more hilly, possesses a less fertile soil, and presents more rock at the surface. The latter, like the upper parts of the Wabash Basin, has its rocky strata buried up in diluvium from the north. In this region lies the Grand Prairie, the largest savanna east of the Mississippi River. The Kaskaskia and its tributaries are, throughout, alluvial streams, that is, have wide and low timbered bottom-lands, subject to inundations, which leave behind them ponds, marshes, and all other varieties of wet surface, overspread with the wreck of their luxuriant vegetation. Such a surface, in the mean latitude of thirty nine degrees, must of necessity give rise to severe autumnal fevers, which are known to prevail throughout the whole Kaskaskia Basin.

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## SECTION III.

## BASIN OF THE ILLINOIS RIVER.

I. OUTLINE DESCRIPTION. — The head-waters of Illinois River approach the southern end of Lake Michigan. On the western side of that lake, and within a few miles of its shores, the River *Des Plaines* originates, and flows to the south, nearly parallel to the same shores. This is one of the elementary streams of the Illinois; the other is the Kankakee. The sources of the latter are near the middle of the northern boundary of the State of Indiana, to the east of Lake Michigan, whence it winds round the end of the lake and flows westerly, until it joins the Des Plaines to form the Illinois. That river then bears off to the south-west and south, to join the Mississippi, twenty miles above the mouth of the Missouri River. Not far below its head the Illinois receives, through its right bank, the waters of Fox River, a large tributary, which originates near Lake Michigan, almost as far north as Milwaukee, in the State of Wisconsin. Below Fox River, all the northern and western tributaries of the Illinois are of very limited extent, as its basin is compressed on those sides, first by Rock River and afterward by the Mississippi; the

former of which, the Illinois approaches at an acute angle, a short distance above the town of Hannopin. On its southern side the basin of the Illinois is much broader, and the tributary streams more numerous, of which the most important is the Sangamon. The upper portions of the Wabash and Kaskaskia basins profigure to us that which we have now entered. Interminable undulating prairies, dry, wet, and marshy, interspersed with groves, and intersected by streams whose wide and low bottoms are overshadowed with trees, characterize every part of the basin. The southern portions are within the coal formation, the northern and north-eastern rest on extensive level out-crops of the Devonian and Silurian rocks, which emerge from beneath the coal. In almost every part of the basin there are deep and extensive deposits of drift from the north. The great depression of the coast of Lake Michigan, at its southern extremity, has been already pointed out, and suggests that, for ages after Lake Erie ceased to send any portion of its waters into the Ohio, a great river continued to flow from Lake Michigan through the valley of the Illinois, into the Mississippi. Recently, a canal has re-established a water communication between the latter river and that lake; which, with the fertility and beautiful aspects of the Illinois Basin, must quickly raise it to a distinction that will impart great interest to its medical topography. With these general observations, let us proceed to the study of particular localities.

II. LOWER PART OF THE ILLINOIS RIVER. — In the month of September, 1844, about two months after the great flood, I ascended the Illinois River eighty-four miles, to Meredosia, and had an opportunity of observing that the deposits which it left on the surface of the broad bottom-lands, were argillaceous, instead of being sandy, like those of the Missouri River, on the opposite side of the Mississippi. The grass and annual herbage, with much of the shrubbery, and many forest trees, had been killed by the submersion. Of the trees, the white hickory (*Carya porcina*) suffered most. This was an extraordinary flood; but the uncultivated state of the bottoms, generally, indicates that they are liable to annual inundation. On one side or the other of the trench through which the river flows, there is a bluff of sub-carboniferous limestone or Devonian sandstone rocks; on the opposite, a low, wooded bottom, abounding in extensive lagoons, ponds, and swamps. There are, however, within the trench, many old and high diluvial terraces, that are never overflowed.

One of these terraces constitutes the site of Meredosia; in traversing which, on the road to Jacksonville, we travel over a sandy surface, then descend a little upon a fertile prairie, and then ascend a bluff, from which the view down the valley confirms what has just been said, as it discloses great breadth, with low prairies and wood-lands, abounding in pools and marshes. It seems almost superfluous to say, that the population along such a valley are subject to grave autumnal fevers.

III. JACKSONVILLE. — From the river to Jacksonville, twenty miles east of Meredosia, the road passes through Morgan County, one of the most populous of the state. The fertile surface is undulating and dry, and presents a



continued series of groves and prairies. The strata beneath are composed of carboniferous limestone, and the water is hard. The site of Jacksonville is an elevated undulating prairie, around which, to the east and north, at the distance of a mile, a sluggish stream, with oak-timbered banks, winds its way to Maunisetter Creek, a tributary of Illinois River. The settlement of this town was begun in the year 1825. It is the seat of the Illinois College, and of the State Institution for the education of the deaf and dumb. From Doctor Jones I learned, that all the forms of autumnal fever occur at this place. Malignant intermittents are rare—remittents, tending to a continued type, rather frequent. Doctor Prosser informed me, that the prevalence of these fevers is much less than formerly. Doctor Smith thought them not more frequent and fatal than he had seen them in the basin of Licking River, Kentucky. Doctor English found them more malignant than he had seen them in the lower valley of the Great Kanawha, in Virginia. On the whole, they prevail here in a mitigated degree, compared with the surrounding region generally, and thus conform to its, apparently, salubrious character.

IV. SPRINGFIELD.—The road from Jacksonville to Springfield—the capital of the State of Illinois—runs directly east, through Morgan and Sangamon counties. The distance is thirty-six miles. The country has an elevated aspect, is gently rolling, and presents groves and prairies in alternation, with a predominance of the latter. In some places, the surface is so wet as to require the roads to be thrown up in the middle; but not a pond nor marsh is to be seen on the whole route. Autumnal fever prevails, but not with such violence as to have prevented a very rapid settlement of the country, and its successful cultivation.

Springfield is situated near the center of the Valley or Basin of Sangamon River, the most important tributary of the Illinois, in N. Lat.  $39^{\circ} 48'$ , and W. Lon.  $89^{\circ} 33'$ . This valley, formerly called the 'Sangamon Country,' is to the State of Illinois, what the valley of the Elkhorn is to the State of Kentucky. A gently rolling surface; numerous streams, which continue to flow through the summer and autumn; a deep and fertile argillaceous soil; extensive prairies, with groves and copses of fine forest; no great extent of inundated bottom-lands, and but few ponds or swamps; constitute its topographical excellencies. Its altitude above the sea is from seven to eight hundred feet. Springfield need not detain us long. The margin and gentle slope of a prairie constitutes its site, with a small stream, along which are open wood-lands, meandering to its west through a rocky channel. Although the conditions requisite to the production of autumnal fever do not seem greatly to abound in the basin of the Sangamon, yet, Doctor Todd, Doctor Henry, Doctor Merriman, and Doctor Jayne, all of Springfield, assured me of its prevalence; and during my sojourn in that city, they afforded me an opportunity of seeing intermittents, as malignant as those which occur on the banks of the Tuscaloosa or Pearl River, seven degrees of latitude further south.

V. BLOOMINGTON.—In advancing northerly from Springfield, toward

In Michigan, the proportion of prairie to wood-land increases. The latter is almost confined to the streams, where it exists in narrow belts. All the larger groves have specific names, as, in regions where the forest predominates, the prairies have received them. The quantity of drift and bowlders increases, and the rocky strata are more buried up. The narrow alluvial bottoms are subject to inundation. The surface is gently rolling, and susceptible of being rendered dry by ditching and cultivation; but in the natural state many of the prairies are wet or marshy. Such is the general character of the country from Springfield to Bloomington, a distance of sixty miles. Its population is sparse. Autumnal fever prevails annually. One of its citizens informed me, that he had resided where I found him three years, before a member of his family was seized with that fever. Such instances are not uncommon, though difficult to explain.

In its topography, the village of Bloomington presents nothing worthy of notice. Prairies surround it, and small head-streams of Kickapoo Creek, which ultimately throw their waters into the Sangamon, are found near it, and supply an adequate amount of wood-land. Doctor Henry, now of Burlington, Iowa, who had resided in the place ten years, regarded it as but little infested with autumnal fever; and spoke of the surrounding country as not being scourged to any great extent. He had become convinced that an extensive plowing up of the soil of the prairies for the first time had been followed by fever; especially in those who resided on the northern or leeward side of such tracts. He had rarely seen malignant cases. These statements were confirmed by Doctor Colburn, of Bloomington.

VI. FROM BLOOMINGTON TO PEORIA. — The distance between these places is about forty miles — the course almost west. For the first ten miles, the rolling prairies are interspersed with narrow belts of wood-land, along the head streams of Kickapoo and Sugar Creeks, — waters which belong to the Sangamon Basin. Diluvial or post-tertiary deposits of sand, gravel, and clay, with erratic bowlders, bury up the carboniferous rocks. The sparse population is moderately affected with autumnal fever. Passing beyond the waters of Sugar Creek, we come on the dividing lands between it and Mackinaw Creek, a tributary of the Illinois. For many miles this tract presents a high, rolling, argillaceous surface, with scattered oak trees and prairie herbage, to the village of Mackinaw, on the western side of which is the creek of that name. The physician of the village, Doctor Burns, who had formerly resided on White River, in the State of Indiana, told me, that there was autumnal fever 'here and there.' Beyond Mackinaw Creek (which has a lively current), the same aspect of country continues for ten miles, when the road descends into an extensive level prairie, on the western side of which is the village of Washington, the inhabitants of which, in the middle of September, were the appearance of good health. From Washington to the immediate valley of Illinois River, the road lies over rolling forest land, with but few inhabitants, and I had no opportunity of comparing its autumnal salubrity with that of the prairies.

VII. PEORIA. — An expansion of the Illinois River to three or four

times its usual breadth, through a length of nearly twenty miles, constitutes what is called Peoria Lake, which is almost without a perceptible current. On the west bank, near the lower or southern end of this expansion, is the beautiful site of the town of Peoria, in N. Lat.  $40^{\circ} 40'$ . The plain rises gradually for a quarter of a mile, then declines a little for the same distance, and is terminated by an abrupt bluff, the summit of which is from eighty to one hundred feet above the surface of the river. From this bluff a rolling prairie and wood-land plain stretches off to the west. Both the upper and the lower terraces are composed of northern drift or diluvium, burying up the carboniferous rocks. Below the town the bluffs recede, so as to give greater width of bottom-land, which at the same time becomes more depressed; — but little of it, however, suffers inundation. On the opposite or eastern side of the river, the bottom is two miles wide, heavily timbered, and subject to overflows of the river; but this tract is to the summer-iceward of the town.

The Anglo-American town of Peoria is of such recent settlement that, in the year 1833, it contained not more than twenty-five families; \* but it had been previously inhabited by the French, who selected it as the site of one of their earliest missions in the Great Interior Valley. In 1770 it began to be a village of Indian traders, voyageurs, and hunters; but such classes of persons would do little toward those transformations of the surface, which modify the public health, and are of interest to the etiologist. Hence, although so old a settlement, its autumnal diseases are substantially the same as those of the recently settled parts of the region we are describing. From Doctor Dickinson, Doctor Rouse, and Doctor Frye, I collected that, in and around the town, intermittents and remittents prevail every year, but to a greater extent in the latter than the former. Mr. Armstrong, an immigrant from Ohio, who established himself on the bluffs in the rear of the town, told me that he and nearly all his family were attacked with intermittents the first year of their residence there.

From Doctor Frye I obtained the following facts, which, however, belong to other localities:

In a part of Tazewell county on the opposite side of the river, a number of families from Ohio formed what was called the Moobury Settlement. For two years, the land they cultivated was at the distance of a few miles from their habitations. They then plowed up the prairie near their residences, and in the following autumn, experienced a decided invasion of remittent fever, while the surrounding population remained healthy. In Peoria county, a number of families had settled (as is common) on the margin of a large prairie, and remained healthy in autumn. At length, a little colony arrived, and establishing themselves near each other, enjoyed excellent health the first year; but the next spring, they broke up a large extent of prairie, near their dwellings, and suffered severely in autumn from fever, while the country around remained comparatively healthy. Doctor Frye has

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\* Peck's Gazetteer of Illinois.



remarked here, what has been noticed elsewhere, that in low and wet timbered spots the intermittent form of fever is more prevalent than the remittent; — also, that in some autumns every kind of locality is affected, while, in others, some places suffer and others escape.

VIII. **PERU AND LA SALLE.** — There are two recently settled towns, above Peoria, where the canal from Lake Michigan has its final termination. They are situated within a mile of each other, on a narrow strip of bottom, and on the adjacent bluffs. On the opposite or left bank of the river, there is a bottom, a mile in width, which is overflowed when the river rises high. The principal physician, Doctor Whitehead, in a residence of eight years, had seen autumnal fever, as an epidemic, in two years only; and then it prevailed chiefly among immigrants from the north, and Irish laborers on the canal.

IX. **OTTAWA.** — From the last towns to this, a distance of sixteen miles, the immediate valley of the Illinois is, in general, about a mile in width, and bounded by rocky bluffs of sandstone, schistose clay, and limestone. These bluffs rise in precipices about one hundred feet high, and are thinly covered with trees. The intervening bottom-lands are chiefly prairie, and so low as to be annually overflowed.

The town of Ottawa is built on the right or north side of the Illinois River, immediately below the mouth of Fox River. There is, first, a narrow slip of bottom, liable to submersion; then a higher alluvial terrace, on which the town is built, on the rear of which runs the canal, and immediately beyond are the bluffs. On the opposite or left-hand side, the river flows near to the cliffs. On each side, it may be seen that the rolling prairies rise still higher than the bluffs. From Doctors Howland, Sehermerhorn, and Hurlbert, I learned that autumnal fever is common in this locality, and that malignant intermittents are not unknown. The Irish laborers on the canal had suffered greatly. The two autumns in which the excavations were going forward, were the sickliest that Doctor Howland had known at this place; but, as the sickness prevailed in the adjoining country, it could not be said to depend on the excavation. The same gentleman had observed that persons living in the open prairies, are healthier in autumn than those who reside near the wood-lands; which may be owing to greater humidity in the latter, as the trees are chiefly in the neighborhood of streams. He had also seen some proofs, that the first plowing up of the prairies is followed by fever.

X. **FROM OTTAWA TO JULIET.** — In leaving Ottawa, the road passes out of the Illinois trench, which here lies east and west, and takes a north-east course, over the dividing lands between Fox River on the west, and the Illinois on the east. The country is elevated, dry, and long-undulating. The streams are few and small. The prairies here spread out into vast dimensions, and, of course, the proportion of wood-land is correspondingly small. Peru and Ottawa are barely within the northern verge of the Illinois coal basin; for, at the distance of twenty miles north-east of the latter, the upper Silurian limestone, lying (geologically) far beneath the coal measures, be-

comes the surface-rock, and so continues to the northern sources of the Illinois River. From the best information I could obtain in reference to this tract, autumnal fever is both rare and mild; proportionate, in fact, to the limited extent of those topographical conditions on which it is supposed to depend.

XI. JULIET.\*—This, like all the towns of the Illinois basin, is of recent settlement. It stands on both sides of the Des Plaines, already mentioned as the northern of two rivers, which, by their union, form the Illinois. A dam across the Des Plaines forms a pond for mill purposes, and to supply the canal. The bed and banks consist of the limestone rock, just mentioned. On the west or right side of the river, there is only terrace enough for a single street; on the opposite side there is a broad rocky flat, resembling the site of Nashville on the Cumberland River. Its surface is above high-water mark. Beyond it is another terrace rising a little higher, and composed of gravel, bowlders, and other varieties of northern drift, which are abundant in the valley of the Des Plaines. There are no drowned lands near the town. From the account given me by Doctor Scholfield and Doctor Bowen, this locality, the latitude of which is about  $41^{\circ} 30'$  N., and its elevation a little below that of Lake Michigan, is annually invaded by autumnal fever, though it seldom assumes either a wide-spreading or fatal character. The Irish laborers on the canal, in 1838 and 1839, as at Peru and Ottawa, were the greatest sufferers.

The road from Juliet to Chicago runs a north-east course, on the west side of the Des Plaines, but not in its immediate valley. The aspect of the country is almost identical with that from Ottawa to Juliet. At the distance of twenty-seven or twenty-eight miles, it descends from these elevated rolling limestone prairies, on which there are occasional deposits of drift, to the Des Plaines, which is found flowing to the south, through what was once an arm or small bay of Lake Michigan, and is now elevated but a few feet above the lake surface. The breadth of this plain, from the river to the lake shore at Chicago, is about twelve miles. Its description can be best given in connection with the Basin of the Lakes.

XII. KANKAKEE RIVER.—This is the larger of the two streams, which, by their junction above the town of Ottawa, form the Illinois. I can say nothing of its topography from personal observation. It traverses Indiana and Illinois from east to west, immediately in the rear of the sand-dunes which surround the southern shore of Lake Michigan. There is a water communication between the sources of this river and the St. Josephs, not far from the entrance of the latter, into Lake Michigan. For a great portion of its whole length, the Kankakee flows through broad swampy prairies; afterward its channel becomes rocky, and its current more rapid.† Before it reaches the Des Plaines, it passes through a more wooded country. As yet the basin of the Kankakee is but thinly peopled, and I cannot speak of its fevers.

\* Properly Joliet.

† Peck's Gazetteer.

## SECTION IV.

## BASIN OF ROCK RIVER.

I. In ascending the Mississippi we come to the mouth of Rock River, three hundred miles above the junction of the Illinois, in N. Lat.  $41^{\circ} 32'$ . The southern or lower part of this basin, lying within the State of Illinois, is compressed into narrow limits, by the Mississippi on the north-west, and the Illinois on the south-east; but the upper or northern portion expands nearly across the southern part of Wisconsin. The extreme sources of this river are found immediately south of Lake Winnebago, near the forty-fourth degree of latitude. Some of its upper waters originate near Lake Michigan, north of Milwaukee; others in the neighborhood of Wisconsin River; while others are found near the Mississippi. Thus, the Rock River Basin covers north-western Illinois and most southern Wisconsin — newly-settled regions of great prospective interest. The north-eastern portions of this basin abound in small lakes, most of which have outlets. It also has prairie-marshes, one of which, called the Winnebago marsh, has an area of forty square miles.\* According to Peck,† this region is overspread with swamps and quagmires, relieved by ridges of sand bearing shrubby oak, or tracts of rich, dry, undulating land. Shaking prairies (*Terre tremblant*) are also common. In traversing this basin from Milwaukee on the lake, to Galena near the Mississippi, under the forty-third parallel, I remarked that after passing through the belt of lofty forest, twelve or fourteen miles wide, which the atmosphere of the lake has quickened into growth, prairies began to appear, on the banks of Fox River, a branch of the Illinois. A well, by the road side, was eighty feet deep, its whole depth being through a bed of drift or transported materials. Soon after crossing Fox River, we passed out of the dense miscellaneous forest, of which the sugar-maple was the predominant tree, and entered open oak wood-lands, interspersed with prairie. In a short time we reached the Basin of Rock River. The country then gradually became more thinly timbered. Many of the oaks resembled the live-oaks on the Mexican coasts. Deposits of drift were extensive, and great primitive bowlders numerous; but here and there the Silurian limestone showed itself in cliffs; the prairies were generally dry; ponds and small lakes now and then appeared; the surface was rolling, and the small streams flowed with lively currents. The descent to Rock River, where Fort Atkinson once stood, was very gentle; beyond that stream, the country became more rolling, and seemed a little more elevated; no dense forest re-appeared, yet the trees, for some distance, were larger. Although the surface was in the main dry, spots of wet prairie were occasionally seen; which aspects continued to —

II. THE FOUR LAKES. — These little lakes lie in a chain, with a lively current from one to the other. The outlet from the first, or most southern,

\* Lapham's Wisconsin.

† Gazetteer of Illinois.



is called Catfish. The area of this lake, according to Captain Cram, United States Topographical Engineer, is five square miles. The water is pollucid. The shores are rolling and uneven, being broken by low bluffs, and interspersed, occasionally, with small marshes. The timber is scanty. The second lake, lying north of the first, has an area of seven square miles. On the north and east, the shore is marshy, with a low gravelly bank intervening between the marsh and the water's edge; on the southern and western shores the land is elevated, undulating, and in some places even knobby. The third lake is intermediate in size and position, between the second and fourth. Its area is six square miles. Its banks are high and undulating, with a scattered growth of oak trees. The fourth or most northern lake covers an area of more than fifteen square miles. The land bordering it is undulating, hilly, and, in many places, broken. Its north side is well timbered. Its shores are overspread with white gravel. Many springs pour into it their pure waters; and it has one small tributary stream, which originates within a few miles of Wisconsin River. The basis of these lakes is a stony Silurian limestone. The difference in level between the first, or lowest, and the fourth, is about four feet. The elevation of the fourth is estimated, by Captain Cram, at two hundred and ten feet over the surface of Lake Michigan, or seven hundred and eighty-eight above the sea.\*

III. MADISON, the young capital of the State of Wisconsin, stands on a neck of land between the third and fourth of the lakes just described, on the west side of the stream which connects them. It fronts on the third lake, from which the ground rises gradually to the height of thirty feet, and is free from marshes. Its Lat. is  $43^{\circ} 5' N.$ ,—its Lon.  $89^{\circ} 6' 30'' W.$ †

IV. AUTUMNAL FEVER.—We have now reached a latitude, in which climate may be supposed, in some degree, to overrule topographical conditions, in the production of autumnal fever; and the question comes up—Is its influence perceptible in the region which has just been described? It is not easy to give a definite answer to this inquiry, for the reason, that the alleged sources of that fever do not, to any great extent, exist within its limits. Yet, from all I could learn, the prevalence of the fever is decidedly less than we find it further south, in localities having nearly the same topography and elevation. At the crossings of Rock River, I was assured by Mr. Foster, that a few mild intermittents make up the sum total of an autumnal invasion; and Doctor Western, of Madison, gave a similar account of that town. He informed me, however, that there had been one sickly autumn at Madison, and one on Rock River, twenty miles below the crossings, at Janesville, which is built on a slip of bottom-land.

V. THE BLUE MOUND REGION.—In going westwardly from Madison, the country gradually rises into the water-shed between Rock River and the Wisconsin, though the road still keeps within the basin of the former. The surface is broadly undulating. No more diluvium or drift of any kind is

\* Lapham's Wisconsin.

† Owen & Locke's Geological Report.

found upon it. The soil or upper surface is composed largely of the disintegrated Silurian rocks, undecayed portions of which are seen, like lofty monuments, rising over the face of the country. They have received specific names, of which the most noted are the Blue Mounds. Ponds and marshes are no longer met with; there is no dense forest; and extensive prairies abound. The grass which covers them is short and thin, like that of the savannas beyond the Mississippi, and the golden *Solidago*, which gives autumnal beauty to prairies not too desiccated in moisture to nourish it, is here replaced by a small bluish-purple aster, which flourishes where the soil is dry. The habitations throughout this region are sparse; and, from all I could learn, intermittent and remittent fevers are exceedingly rare.

VI. DODGEVILLE. — This lead-mining village, situated in the region which has just been described, presents in its topography small streams, without much alluvial bottom, and long gentle slopes, partly covered with prairie grass, and partly with open oak woods, or copses of hazle bushes. From Governor Dodge, who had resided here about sixteen years, I learned that autumnal fever is almost unknown; a statement which was confirmed by Mrs. Black, an observing and intelligent lady, who had lived on the spot for nearly the same length of time. The mining population of the village and its neighborhood is about five hundred, — chiefly immigrants from England.

VII. MINERAL POINT is found ten miles south of Dodgeville; the country between presenting prairie, and open woods covering long slopes and ridges. The streams are generally small. Mineral Point, however, is on the banks and adjoining hills of a creek, sufficiently large to move the machinery required in the smelting of lead ore; and which is joined, below the village, by another of the same size — the common trunk opening into the Peckatonica, one of the tributaries of Rock River. There are no ponds or marshes around Mineral Point, but the stream along which the town is built presents some narrow belts of boggy soil. The population of this town is about one thousand. According to Doctor Palford, the people who live near the stream below the town are subject to autumnal fever, from which the inhabitants of the town itself are not entirely exempt. This liability, compared with that of the people of Dodgeville, seems to result entirely from the presence of water-courses in this locality, and their absence from that. The Peckatonica is the most western stream of the Rock River Basin, and interlocks with the head-waters of Fever River, and other small tributaries of the Mississippi. According to Tappan, its waters are turbid and its current sluggish; but of the influence of its valley in the production of autumnal fever I know nothing. Nor can I speak of the medical topography of the lower portions of Rock River Basin, lying within the State of Illinois, which, however, are of no great extent.

## SECTION V.

## REMAINDER OF THE SOUTHERN BASIN.

I. THE WISCONSIN RIVER. — Although there are many interlockings between the tributaries of Rock River and the Wisconsin, the latter enters the Mississippi more than two hundred miles above the former, about the forty-third degree of latitude; while its extreme sources are near the forty-sixth degree, in connection with streams which flow into Green Bay and Lake Superior. For two-thirds of its course, it flows to the south, and then turns almost as directly west. At this elbow or *detour*, it approaches within a mile and a half of Fox River, a tributary of Green Bay. The Wisconsin Basin is very long, compared with its breadth. Although this is the river, down which the upper Mississippi was approached and discovered, by Father Marquette, one hundred and seventy-five years ago, there are very few settlements above the elbow; and none of any importance to the medical topographer below that bend. North and west of Wisconsin River, the large remainder of the Mississippi Basin is almost an unclaimed and unsettled region. The first considerable river beyond that we are now examining, is the Chippeway, of which I cannot say anything. Of the next — the St. Croix — I am enabled to speak briefly, on the authority of Doctor Shumard, Assistant United States' Geologist.

II. RIVER AND LAKE OF ST. CROIX. — The river St. Croix has its origin in a great number of small lakes, immediately south of the west end of Lake Superior, above the forty-sixth degree of north latitude, and, after flowing to the south-west for half its course, turns directly south, until it joins the Mississippi, which it finds running to the south-east. The place of junction is only ten miles below the mouth of the St. Peter's, in Lat.  $44^{\circ} 45' 30''$  N., and at an elevation above the sea of seven hundred and twenty-nine feet; that of the neighboring hills being eight hundred and sixty-six feet.\* Through its lower thirty miles, the current is almost imperceptible, and the surface of the stream is expanded to half a mile or a mile in width. This constitutes the lake, the shores of which present many bowlders, reposing on old Silurian rocks of magnesian limestone and sandstone. One of the hills near the lake rises to the height of three hundred and forty-nine feet above its surface, or ten hundred and seventy feet above the sea.

STILLWATER, the only settlement on this lake, is a new village, on the western side, near its head, containing about five hundred inhabitants. It stands on a dry plain, which slopes from the bluffs to the water's edge. Immediately to the north, there are swales which are kept up by spring-water, and in the contiguous river-bottoms there is some marshy ground; — both, however, lie to the summer-windward of the village. As to autumnal fever, Doctor Shumard learned from the physician of the place, that intermittents of a mild character occur every year, but the proportion of cases to the population is small.

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\* Nicollet: Hydrographical Basin.



**THE FALLS.** — The other settlement on the St. Croix is at the falls or rapids, about thirty miles above Stillwater, in Lat.  $45^{\circ} 30' 10''$  N. The descent of the river is over trap-rocks, ranges of which begin to show themselves twenty-four miles above the lake. For several miles above the lakes the sandstone hills approach the river, but beyond that point the bottoms widen and become swampy, and are overshadowed with cotton-wood and maple trees, the hills abounding in pine. There is a pine saw-mill at the falls, and the pine lumber trade is the object of this settlement, the most northern in the basin of the Mississippi. Doctor Shumard ascertained that a few cases of intermittent fever happen here every autumn. The tributaries of this river abound in trout. The neck of land between the St. Croix and the Mississippi presents a succession of small lakes and tamarack swamps, with interspersed tracts of dry land, clothed with scrubby oaks and hazle bushes.

It appears from what has been said, that we have not yet reached the limit of sporadic intermittent fever, in the southern basin; but have passed beyond the line of its epidemic prevalence.

**III. SOURCES OF THE MISSISSIPPI.** — The St. Croix, just described, is the last considerable tributary of the east or left side of the Mississippi. Ten miles above its mouth we come, on the opposite or western side, to the junction of the St. Peter's, above which stands Fort Snelling, the most northern post of the Southern Basin. Nine or ten miles above, are the Falls of St. Anthony, where the surface of the river is eight hundred and fifty-six feet, and that of the hill-land about one thousand feet, above the Gulf of Mexico. This elevation of the river has been attained through sixteen degrees of latitude. Two degrees and a half further north ( $47^{\circ} 30'$ ), bring us to the extreme sources of the river, where the water-level is fifteen hundred and thirty-two, and the highest land sixteen hundred and eighty feet. This rapid ascent indicates that above the Falls of St. Anthony there is a great swell or tuberosity, on the gentle slopes and summit of which the great river has its sources. The width of this region is about two and a half degrees of longitude. On the west, it is limited by the St. Peters, and Red River of the north; on the east by the St. Louis, and other short tributaries of the west end of Lake Superior. From the expeditions of Pike, Cass, and Schoolcraft, but, above all, from the hydrographical map of Nicollot, it appears, that the whole of this region abounds in swamps, ponds, and small lakes, connected by bayous into the most remarkable hydrographical labyrinth, to be found within the limits of the Southern Basin. As yet it is unsettled, except by a few fur-traders and missionaries, whose business is with the Indians. Of the extent to which autumnal fever occurs among them, I cannot speak; but it must be very limited. At Mackinac, in 1842, I met with an educated Indian — John Johnson, attached to the Methodist Mission family, stationed near the American Fur Company's establishment, on the banks of Sandy Lake, about Lat.  $46^{\circ} 48'$  N., — who informed me that ague and fever occasionally occurred among them. The altitude of that

lake, according to Nicollet, is twelve hundred and fifty-three feet above the gulf.

The medical topography of the Southern Basin is now brought to a close. Although it has extended through more than three hundred pages, a very small portion of its localities have been described; yet enough I hope have been introduced, to afford a tolerable representation of the whole. Beginning within the tropics, we have traveled north through nearly thirty degrees of latitude, and gradually risen from the level of the Gulf of Mexico, to the summit of the great interior hydrographical center, the average elevation of which may be taken at fifteen hundred feet.

From this important interior hydrographical center, we are now to descend eastwardly into the Lake, St. Lawrence, or Eastern Basin.

## CHAPTER XII.

### THE EASTERN, OR ST. LAWRENCE HYDROGRAPHICAL BASIN.

#### GENERAL VIEWS OF THE WHOLE BASIN: LAKES SUPERIOR, MICHIGAN, AND HURON.

The limits of this basin have been already drawn (*p.* 20). Its position in relation to the center of the Mexican or Southern Basin, is north-east. Most of it lies directly north of the Ohio Basin. In reference to latitudes, it may be said, in general terms, to be comprehended between the fortieth and fiftieth parallels. On many points besides latitude, it differs from the basin which has been topographically described. That basin is without a single large lake—this includes a chain of the largest on the continent: that has an extensive *sea-coast*—this has a still more extended *lake-coast*: that is distinguished for the vast length and volume of its numerous rivers—this has not one large river, save the St. Lawrence—the outlet of the lakes: that is bounded on the west, through its whole extent, by many ranges of high mountains—this has a plain of immense extent on the same side: large portions of that present an arid surface, and

are destitute of trees—this is everywhere humid and generally overshadowed by forests, interspersed with a few savannas: the southern population of the Great Interior Valley belongs to that—the northern population to this: in that, the etiologist may study the influences of a wet surface, abounding in organic matter, when acted upon by the heat of a long southern summer—in this, the same influences, in a summer comparatively short and cool. In making this comparison, however, we are prevented, by want of population, from going at present beyond the latitude of  $47^{\circ}$ .

In describing the Southern Basin, we started from the Gulf of Mexico, and ascended the great rivers. By this method, the description terminated with that portion which lies contiguous to the extreme sources of the St. Lawrence, which—under the name of the River St. Louis—throws its waters into the western extremity of Lake Superior;—and here we shall begin the medico-topographical description of the Eastern Basin; thus reversing the order pursued in the Southern, by descending to the sea, instead of rising from it; and at the same time advancing with unbroken continuity.

## SECTION I.

### BASIN OF LAKE SUPERIOR.

I. This is the largest lake of the continent, and the most northern and western of those included in the St. Lawrence Basin. Its southern affluents interlock with those of Lake Michigan, Green Bay, and the Mississippi River; its western with those of that river only; its northern with those of Hudson Bay; its eastern with streams which fall into Lake Huron.

The area of Lake Superior is estimated at thirty-two thousand square miles, most of which lies between the forty-seventh and forty-eighth parallels of latitude; its mean depth is about nine hundred feet. Its level above the sea, according to the geologists of Michigan,\* is five hundred and ninety-six feet, according to Nicolle†, six hundred and twenty.‡ The average altitude of the country around it, may be taken at one thousand feet more, or sixteen hundred above tide-water in the Gulf of St. Lawrence. The basin of this lake lies distinctly within the primitive or oldest transition rocks, with extensive trap formations. In contrasting the coasts of this inland sea with those of the Gulf of Mexico, we find them lofty, bold, rocky, and metalliferous: while the latter are low, flat, and swampy. Lake Superior, however, is not without coast-marshes; and some of its rivers overflow their banks, near their entrance into the lake. In the month of July, Mr. Schooner† found its mean surface-temperature, on the south side,  $61^{\circ}$  Fahrenheit.§ The country around Lake Superior is a vast, rugged, and uninhabited wilderness, but there are a few settlements, to which reference may be made.

\* Second report.

† Nar. Journal of Travels, 1821.

‡ Hydrographical Basin.



II. **FORT WILLIAM.**—The British North-west Company have an establishment near the mouth of Dog or Kaministiquia River, in Lat.  $48^{\circ} 24'$  N., called Fort William. According to Long,\* a plain of considerable extent surrounds this village, which is on the river bank, a mile from the lake. This was once an important depot for the fur trade, and was inhabited by eighty partners and clerks of the company, many of whom had families. In latter years, the population has been less. In consulting every authority within my reach, I find no reference to autumnal fever at this place; and Doctor Rowand, late of Quebec, who has several times sojourned there, assures me that intermittents and remittents are unknown.

III. **RIVER ST. LOUIS, AND FOND DU LAC.**—This river originates on the high summit-level west of Lake Superior, and descends, by a series of falls and rapids, to the western extremity of the Lake. It may be regarded as the beginning of the St. Lawrence, and is the highway of the *voyageurs* of the American Fur Company. On its estuary is the establishment called Fond du Lac, in Lat.  $46^{\circ} 40'$ .† I cannot find in any book of voyages or travels, a reference to autumnal fever, as occurring in this locality.

IV. **SOUTHERN COAST—COPPER REGION.**—Within the last few years the copper region on the southern coast of Lake Superior, has been the resort and summer residence of a great number of persons, who have led there lives of great exposure. I have not learned that autumnal fever has been one of their diseases; on the contrary, Mr. Charles Whittlesey, of Ohio, topographical surveyor, writes to me as follows:—"The exposure I underwent, on the southern shore, this fall (1845), would have ended in ague and fever, or some other bilious attack, almost anywhere south of Lake Erie; but here, my companions and myself not only escaped that disease, but enjoyed extraordinary health. We followed the coast westwardly, from the St. Mary, in an open boat, and, with the exception of a friend, who started with his system overflowing with bile, no ailment was felt by any of us. From the 13th of September to the 18th of October, we were in the woods; the season was rainy, and we were often wet for several days together, with no covering at night, except our blankets; yet we never felt better. Much of the land we wandered over was high, rolling, and heavily timbered with sugar maple; there are, also, low lands and cedar swamps, but they send up no miasma, and their waters served us for drinking and cooking, as well as those of running brooks. The latter are cold and rapid, with rocky beds, and it is only necessary for me to add that they abound in speckled trout, to show you that they are as pure as any waters that flow." The average latitude of the region in which these observations were made, is  $46^{\circ} 30'$  N.

V. **ST. MARY STRAITS.**—The outlet of Lake Superior, is at its eastern extremity, and known under the name of St. Mary Straits or River. Its efflux is at the base of a rounded, rocky promontory, on the British side,

\*Second Expedition, Vol. II.

† Nicollet.

known by the voyageurs as *Tros Cap*. The gentle current of the St. Mary flows in a shallow sand and gravel trench, varying from half a mile to two miles in width. The banks, nearly uninhabited, are low, in many places wet, and, throughout, heavily timbered with pine, hemlock, maple, and other trees. At the distance of sixteen miles, we reach the falls, or *Sault de Ste. Marie*,\* where the river descends eighteen feet, down a broad inclined plain, overspread with vast granitic bowlders, solitary or in island-groups, at the foot of which, on the British side, there is a small settlement;—on the American side, an inconsiderable fur-trading village, and a military post.

FORT BRADY, stands in N. Lat.  $40^{\circ} 30'$ , and W. Lon.  $84^{\circ} 43'$ . "The right bank of the St. Mary, which is here three-fourths of a mile in width, presents a gradual slope for the distance of two hundred and fifty feet, gaining in that space an elevation of fourteen feet, in the rear of which the surface of the country approximates a level. For three hundred yards from the bank of the river, the soil is cleared of timber, and is, although not very productive, in a state of cultivation. Immediately adjoining this cultivated ground, is a marsh, half a mile wide, beyond which high lands appear. This marsh extends five or six miles down the river, in a south-east direction, and west and south-west for fifteen or twenty miles. It is covered with some large forest trees, and a thick growth of under-wood. On the opposite side of the river, the country is undulating and mountainous, and covered with a dense forest." "The west and south-east winds pass over the marshes."†

It is undeniable, that all the topographical conditions necessary to the production of violent autumnal fever, are present in this locality; which includes, in addition to the garrison, a village inhabited or frequented by Americans, French voyageurs, and Indians, with their intermediate progeny. My visit was in the last week of July, yet I saw no autumnal fever, and was assured by persons long familiar with the spot, that it does not occur, except in persons who have, in summer or autumn, visited places further south. The returns from the post, however, show that the troops are not entirely exempt. Thus, through a period of ten years, with a mean strength of ninety-six men, there were, in all, thirty-seven cases of intermittent, and three of remittent, or about four per cent. *per annum*. When we connect with this low ratio, the facts, that troops are seldom kept long at one post, and that relapses into intermittent fever may continue to occur for a long time after the first attack, we are, perhaps, at liberty to suppose, that most of those reported from this post were contracted in more southern latitudes; a conclusion which is strengthened, by the great disparity between the number of intermittents and the number of remittents, and by the occurrence of nearly all the former in the spring of the year. Thus we see that on the St. Mary, in N. Lat.  $40^{\circ} 30'$ , if the climate do not annihilate the topographi-

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\* Called by the Voyageurs—'The Soo.'

† Medical Statistics of U. S. A.

cal influences producing those diseases, it reduces their effects to a minimum.

From Gros Cap to the Sault, the course of the St. Mary is a little north of east; afterward it turns strongly to the south, and, widening, becomes gradually a shallow western extremity or head of Lake Huron, embracing several islands. The banks of this connecting strait, below Fort Brady, like those above, are clothed with dense forests to the water's edge, and are nearly destitute of inhabitants. To the north is a range of high sandstone hills, which, extending westwardly, touch the lake at the outlet of the St. Mary, and constitute the promontory called Gros Cap. Beyond these hills, in the direction of Hudson Bay, the country is a wilderness, abounding in swamps and small lakes. Although, in following the St. Mary, we are conducted to Lake Huron, it will be most convenient to describe Lake Michigan first.

## SECTION II.

### BASIN OF LAKE MICHIGAN.

I. GENERAL DESCRIPTION. — The position of the northern extremity of Lake Michigan is directly south of the eastern end of Lake Superior, between which there is an unsettled peninsula, bounded on the east by the St. Mary. Michigan is a long but comparatively narrow lake, having its axis nearly in the eighty-seventh meridian, and consequently at right angles with that of Lake Superior. Its northern border reaches the forty-sixth degree of latitude, while its southern — properly its head, — is found about  $41^{\circ} 40'$  N. Its area is estimated by Higgins at twenty-two thousand square miles.\* Green Bay, which opens into it on the north-west, is computed at two thousand more, making twenty-four thousand, or nearly five-sixths of the area of Lake Superior. Its elevation above the sea is five hundred and seventy-eight feet. Its mean depth is stated at one thousand feet — that of Green Bay at five hundred. Lake Michigan is connected with Lake Huron by the Straits of Mackinac (*Pl. XIV*), in which there is no perceptible current; yet all the water which flows or falls into the former lake, beyond what is absorbed or evaporated, finds its way to the ocean through that channel. Lake Michigan lies, through its whole extent, within the upper and lower, or gray and blue, Silurian limestone. The country near it is not rugged, like that which encompasses Lake Superior; but its banks are, in general, well developed, and the ascent from them to the surrounding watersheds or summit-levels, is gradual. Its principal rivers are the Menomonee and Fox River, on the north-west, which discharge their waters into Green Bay; and Grand River, the Kalamazoo, and St. Josephs, on the south-east. From the head of Green Bay north-east to the Straits of Mackinac, its shores are but little settled; and further north and north-west, up to the

\* Geological Survey of the State of Michigan.



Lake Superior Basin, in what is called the upper peninsula of Michigan, the country is an uninviting and nearly unbroken wilderness. South of Green Bay, in Wisconsin and Illinois, and round the head of the lake, in Indiana, to a point in Michigan, on the eastern side of the lake, corresponding with the head of that bay, the attractive character of the soil has, within the last twenty years, led to an extensive immigration, and thus rendered the southern half of the Michigan Basin decidedly interesting to the medical topographer. In some places the shores are bold, and composed either of rocks or compact tertiary clay or gravel deposits; but there are many extensive tracts of low ground, some of which are subject to inundation, from the movement of the waters under the influence of winds; while others have been raised above this kind of inundation, by dunes of blown sand from the beach. These spots appear to have been estuaries and small bays, filled up by the alluvion of streams and the moving sands of the lake. Some of them are yet quagmires, with a crust of hardened earth, bound together by the roots of grass, and bearing a resemblance to the new lands in the Delta of the Mississippi.

In a returning voyage from Green Bay to Mackinac, July 28th and 29th, 1842, I found the surface-temperature, between Lat.  $45^{\circ}$  and  $46^{\circ}$ , as follows:

Harbor of Navarino, shallow water,	-	-	-	-	-	78°
The Bay, one hour's run, off the shoals,	-	-	-	-	-	74°
" two " "	-	-	-	-	-	70°
Lake Michigan, three hours' run,	-	-	-	-	-	68°
" seven " "	-	-	-	-	-	66°
" twelve " "	-	-	-	-	-	58°
" fourteen " "	-	-	-	-	-	50°
" sixteen " "	-	-	-	-	-	62°
" seventeen " "	-	-	-	-	-	68°
Straits of Mackinac, eighteen hours' run,	-	-	-	-	-	64°

From these observations it will be seen that the shallow water is warmest. The high temperature of the harbor of Navarino should be ascribed in part to the influence of Fox River, which descends from the south.

II. GREEN BAY. — The entrance into this bay presents some beautiful islands, composed of the upper Silurian limestone, arranged into mural precipices, which have been whitened by the action of the waves and weather, while their summits are crowned with green trees. The bay is long and narrow, with an axis nearly parallel to that of Lake Michigan. Fox River enters its apex, and presents, on the left or west bank of its estuary, the relinquished and ungarrisoned Fort Howard; on its east, the new villages of Navarino and Astor, — better known, however, under the name of Green Bay. The fort and villages belong properly to one locality, as the estuary which separates them is narrow.

The banks of Green Bay are generally low and densely wooded, with but few settlements. As we approach its head, flat, green savannas show them-

selves on both sides. According to Doctor Ward,\* the head of the bay is skirted with "marshes a mile in width, covered with a luxuriant growth of grass and wild rice, which embrace the mouth of the river, and continue within half a mile of the fort. The water is from six inches to six feet deep on these marshes, which, by the operation of a diurnal flux and reflux of the waters of the bay, are alternately flooded and drained twice every twenty-four hours. Twenty rods back of the fort, another marsh begins, and spreading to the right and left, extends a mile or more in each direction;" that is, to the north-east and south-west: it differs from the other in being partly covered with trees and shrubs, though still abounding in grass. Beyond this is a dry and thickly-wooded plain.

The site of the villages on the opposite side of the estuary, is elevated above the swells of the bay, but abounds, or has abounded, in limited swales or marshes, chiefly dried up since the settlement of the place; leaving deposits of organic matter in their little basins. The plain rises slowly from the river and then declines to the east or north-east, until it terminates at Devil or East River, a stream which approaches the bay nearly parallel with Fox River. Beyond the former the terrace is more elevated, and supports a grove of pine. The neck of land between these rivers, is composed largely of dark sand, colored perhaps by organic matter, and overspread with boulders of primitive rocks.

I must recur to the swells in the bay, mentioned by Doctor Ward. A regular flux and reflux, twice in the twenty-four hours, would suggest lunar tides; but they are not of that kind; nor, in fact, do they appear with that regularity which his language would suggest. The winds, by changing the level of the waters of the lake and the bay, are the efficient cause of the so-called tides, along the low shores of the latter. These tides are occasionally much greater than common, and depend equally on the south-west and the north-east winds. That currents of air, moving in opposite directions, can produce them, may be understood, by looking on the hydrographical map (*Pl. I*). When the wind is from the north-east, it heaps up the waters of the bay at its head, and when it flows from the south-west, it accumulates the waters of the lake in its northern extremity, whence they flow off into the bay, and raise its level. To the perpetual or frequent submergence of the marshes in this locality, Doctor Forry, in his commentaries on the reports from Fort Howard, ascribes its well-known autumnal salubrity. This, from what I was told in 1842, has always been great.

Thus, Doctor Armstrong, after a residence of seven years in Navarino, declared to me, that intermittent and remittent fevers are almost unknown among its inhabitants; and Mr. Allen and Mr. Horner, two intelligent gentlemen, confirmed his statement. Mr. Ryan, a respectable Indian trader, who had resided there much longer than either, assured me that intermittent fever was unknown, among both the whites and the Indians; but that a mild remittent fever had prevailed in the year 1828. The army returns do not

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\* Medical Statistics U. S. A.

however, present so great an exemption; for, through a period of ten years, "the annual ratio of intermittents was six, and of remittents three, per one hundred of mean strength;" \*—a rate of prevalence a little greater than at Fort Brady; yet in no degree approaching the ratios of more southern localities, under similar topographical circumstances.

III. Fox River is the outlet of Lake Winnobago. The position of that lake is to the south-east of Green Bay, at the greater elevation of one hundred and sixty feet,† or seven hundred and thirty-eight above the sea. Before Fox River enters the lake from the south-west, it is joined by Wolf River, from the north, which has made its way through several small lakes; in fact, the country around Lake Winnobago abounds in ponds and extensive marshes, from some of which Rock River, already described in the Southern Basin, takes its origin. In ascending Fox River, above its entrance into Lake Winnobago, we arrive at the spot where, having descended from the north, it approaches within a mile of the river Wisconsin; when it turns suddenly to the north-east, and the Wisconsin as suddenly to the south-west. It was over this portage, that the valley of the Mississippi was first entered from the Basin of the Lakes by Marquette. Its elevation above Lake Michigan is two hundred and twenty-three feet—above the sea eight hundred. Its distance from the head of Green Bay is one hundred and twelve miles—from the western shore of Lake Michigan, eighty-one miles.

IV. FORT WINNEBAGO.—This military post stands in N. Lat. 43° 31', and W. Lon. 80° 28', on the north-east margin of the isthmus or portage just mentioned, near the right bank of Fox River. The isthmus is a marsh, over which the Wisconsin in high floods pours its waters, to the depth of three feet; when a portion of them flow into Fox River, to find their way to the ocean by the St. Lawrence, instead of the Mississippi. Other swamps exist in this locality. In fact, both sides of each river are bordered with marshy alluvions, of which Doctor Foot\* remarks:—"In cutting through the thick vegetable matter on the surface, from two to four feet thick, you come to a stratum of soft mud, generally a foot or two in thickness. In a few places, however, this stratum of mud and water is from eight to ten feet deep. These are known by the name of 'shaking marshes,' and are dangerous to cross with horses. They appear, however, to be filling up, from the same causes that have made the others more solid." Beneath the mud and water is a stratum of fine silicious sand, which is believed by Doctor Foot to be of animalcular origin. He supposes these marshes to have been originally shallow lakes or lagoons, full of aquatic plants, which were then, as now, covered with myriads of animalcules, whose shells were pure siliceous. As these died annually, each one deposited its particle of siliceous matter, until, in the process of time, the lagoon became filled up, having below a stratum of sand, and above an imperfectly organized soil, formed by the annually decaying vegetation.

\* Medical Statistics U. S. A.

† Medical Statistics U. S. A., p. 150.

† Lapham's Wisconsin.



According to the army returns for ten years, the annual ratio of cases of intermittent fever at this post, is but five per cent. ; and of remittent, one and a third per cent. ; less, even, than at Fort Howard ; notwithstanding the topography of this spot so eminently favors the production of those fevers. It is, moreover, nearly a degree further south ; but, at the same time, two hundred and twenty feet higher ; which, in reference to the heat of summer, may perhaps compensate for the difference of latitude. It would appear from these statistics that, at Fort Winnebago, a latitude of forty-three degrees and a half, and an elevation of eight hundred feet, greatly control the noxious autumnal influence of extensive bogs and marshes, abounding in organic matter.

V. MILWAUKIE. — The small bay of Milwaukee is a semi-circular indentation on the western coast of Lake Michigan, about the forty-third degree of north latitude. Its length is six miles, and its depth, or projection into the land, three. The shores of this portion of the lake are composed of a post-tertiary clay deposit, from twenty to one hundred feet in height. The bottom of the bay has been filled up by the alluvion of two small rivers, the Milwaukee and Menomonee, which unite as they enter it. In their common valley, and on the adjacent sloping tertiary plain, to the north, stands the new and rapidly growing town of Milwaukee. After passing through it, the river enters that part of the bay which has been filled up, and winds its way, as a deep and narrow canal, to the lake. The space between the town and the mouth of the river, is an impassable morass, bridged over with a stratum of indurated alluvion, bound together by the roots of the grasses which it nourishes. This crust being penetrated, the soft mud has been sounded to the depth of more than forty feet, without finding bottom.\* A part of the bottom on which the town is built, was a wooded swamp, which has been reclaimed. As both the estuary and the marshes of the bay lie to the south of the center of the town, the summer and autumnal exhalations are wafted over it by the winds. Thus, Milwaukee, topographically considered, would be pronounced a sickly town ; but such is not the fact. Nevertheless, intermittent and remittent fevers prevail more at this place than at Green Bay, a degree further north, but on the same level ; or at Fort Winnebago, half a degree further north, and two hundred feet higher. Still, their prevalence is far less than in some more promising localities in lower latitudes. Thus, Doctor Bean, who had practiced medicine in the latitude of 41°, on the highlands of Illinois, west of Peoria, assured me, that he found much less autumnal fever at his present, than his former residence. In three years, he had seen but five or six cases, all of which were mild ; and the number of remittents had been still smaller. This statement, however, excludes some cases in which the disease was contracted elsewhere. Doctor Hewett, who had resided in Milwaukee a longer period of time, had seen rather more of these diseases, especially in the autumns of 1880 and 1840 ; yet some seasons had passed away, without presenting scarcely a single case.

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\* Lapham's Wisconsin.

VI. RACINE. — From Milwaukee to Racine, twenty-five miles, a belt of compact and lofty forest, nourished by the influences of the lake, spreads to the distance of two or three miles into the country, beyond which, there are rolling prairies. The site of Racine, in N. Lat.  $42^{\circ} 50'$ , is a part of this wooded plain, elevated from thirty to fifty feet above the lake. In rainy weather, small pools of water form on many parts of its surface. In digging wells, as Doctor Cary informed me, they pass through a bed of sandy loam, and then through a deposit of gravel, into another of blue clay, with pebbles, when pure but hard water is obtained. At the same level, springs burst out from the banks of Root River, which enters the lake, adjacent to the northern side of the town. The valley of this river, for two or three miles up, is about sixty rods in width, and not subject to inundation. Doctor Cary, who had resided in the place ten years, that is, from the beginning of its settlement, informed me, that for the first two years, there was scarcely a case of autumnal fever; in the next two, a number of cases occurred; and in the following year, 1830, it assumed a mild epidemic character, putting on an intermittent type, and proving fatal in a single instance only. The following year it was again epidemic. In both those years, the mouth of Root River was choked up with sand, and its waters rendered stagnant. In the next three or four years, the cases were very few. Doctor Graves, who had resided eight years in the place, confirmed the statement of Doctor Cary, and added, that every autumn some cases of remittent fever occurred. It appears from these accounts, that, below the latitude of  $43^{\circ}$ , on the shores of Lake Michigan, a locality presenting but few of the topographical conditions which produce autumnal fever, is much more infested than places further north, in which those conditions exist in a far greater degree; as at Green Bay and Port Winnebago.

VII. CHICAGO, the commercial metropolis of Lake Michigan, stands on a low sand-plain, on the western side of the lake, in N. Lat.  $41^{\circ} 51'$ , and W. Lon.  $87^{\circ} 35'$ . The breadth of this flat along the lake is about four miles, whence it runs back ten or twelve miles to the River *Des Plaines*, an elementary branch of the Illinois, described in the last chapter. When the lake stood at a level only twenty feet higher than at present, its waters overspread this bed of alluvion, and a portion of them flowed down the Illinois. At this time it is a savanna, abounding in marshes and low sand-ridges; traversed by the river just mentioned, on the west, and on the east by the north and south forks of Chicago River or Creek; which, flowing nearly parallel with the lake shore, and at a short distance from it, unite within it, and form a short common trunk, which meanders through its center, to the lake. The water in this natural canal is twenty feet in depth, and rises and falls, from the force of winds upon the lake, about two feet; a fluctuation which tends to carry away the silt which would otherwise accumulate on its margins, from the houses on each side, and from the vessels which seek it, as the only harbor of Chicago. From the mouth of this river there is a gradual rise of the plain, to the height of twenty feet; which may be attained by ascending the south fork of the river, to a spot whence streams sometimes

flow to the east and west, on which canoes have passed from the lake into the Illinois River. The canal from Chicago to Peru, mentioned in the last chapter, now passes over that summit-level, which is the lowest between the Gulf of St. Lawrence and the Gulf of Mexico, being, in round numbers, only six hundred feet. Near the lake shore, the winds are constantly blowing a fine dark-colored sand on the margin of the plain, which, south of the town, is raised into low ridgy dunes. The town-plot, from the destruction of the coarse sub-aquatic vegetation, and the tramping of men and animals, is constantly becoming dryer and firmer. Beyond these influences, much of it inclines to marshiness; but as it is not subject to inundation, and is high enough above the Chicago and Des Plaines Rivers, to be drained, by a judicious system of ditching, it will, no doubt, as population increases, be entirely reclaimed.

FORT DEARBORN, a vacated military post, stands on a sand-dune, immediately south of the entrance of Chicago River into the lake.

The site of Chicago was occupied in early times by the French, but they never resided on it in large numbers. It was, by the American government, made a military post, and an Indian agency. In the year 1831, the town itself was commenced; and at this time (1848), its population is near twenty thousand. The city is supplied with water from the lake, through a hydrant-system. A growth so rapid indicates its prospective importance, and entitles it to the regard of the medical topographer. Situated on the eastern or leeward margin of a wet or marshy plain of great extent, it would, in a southern climate, be classed with the sickliest localities. Let us inquire, then, into the extent of the countervailing influence of its latitude, which is nearly that of 42°.

According to the returns from Fort Dearborn, for ten years, the annual ratio of its intermittents was twenty-three per cent.,—that of its remittents, four per cent.\* The annual ratio at Fort Wood, on the Gulf of Mexico, having Lake Borgno on one side, and a cypress swamp on the other, was, through the same period,—intermittents seventy-six,—remittents twenty-seven. These posts are about twelve degrees apart; and to this difference of latitude we may ascribe the different degrees of autumnal fever, experienced by their respective garrisons through the same period; a difference which may be expressed by saying, that while one hundred men would present but twenty-seven cases of fever at Fort Dearborn, the same number would present one hundred and three cases at Fort Wood. On the other hand, however, we find the proportion at Fort Dearborn greater than at Fort Winnebago and Fort Howard, both lying further north, and the former at an elevation two hundred feet higher.

From Professor Brainard, of Rush Medical College, I received statements, which, when compared with those of the medical gentlemen of Green Bay, Milwaukee, and Racine, indicate a decidedly greater prevalence of autumnal fever in Chicago than in those towns; but he had not met with malignant

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\* Medical Statistics U. S. A., p. 87.



cases. The accounts given me by Doctor Kimberly were less favorable than those of Professor Brainard. He spoke, particularly, of the year 1836, when the crowd of strangers was great, while the town-plot was still pondy or marshy, and a great deal of wet prairie was broken up with the plow. The statements of Doctors Boon, Davidson, and Brinkerhoff, fully sustained the impression made by the others, and convinced me that the town of Chicago has been more infested with autumnal fever than Fort Dearborn had been; which goes to strengthen the prevalent opinion, that the first exposure of the new soil to the sun, rain, and air, is insalubrious. A part of this up-turning was by the plow, another by the spade in the excavation of the canal. This operation deserves some notice. The canal stretches south-westerly from the town completely across the plain. One of the contractors told me, that, in 1838, he had excavated a mile. The average digging was to the depth of four feet, through a soft black mold, abounding in organic matter. The distance to which this silt was spread out, on each side, was such as to cover a parallelogram of the average width of two hundred and eighty feet, exposed to sun and rain. Doctor Boone had ample opportunities of observing the effect of this proceeding on the health of the people. Nearly all who resided along the line of excavation, sickened with autumnal fever; and almost all the laborers (Irish immigrants) suffered in the same way. Several died with malignant or congestive symptoms.

VIII. MICHIGAN CITY. This newly-settled town, in the State of Indiana, is situate near the vortex, or southern extremity, of the lake whose name it bears. In passing round the head of the lake from Chicago, it is seen that a belt, three or four miles wide, consists of dunes or hillocks of blown sand, thinly covered with trees. They vary in height from twenty up to one hundred feet, are of all forms, and give origin to no streams, but inclose ponds of water. The sand is generally white or gray; the soil is very thin, and bears but few herbaceous plants.\* Behind this belt, there is, according to Doctor Pulford, formerly of Michigan City, now of Mineral Point, Wisconsin, a broad prairie-marsh, and then, at a little higher level, a tract of woodland five or six miles wide. To this succeeds a dry and rolling prairie, from ten to twenty miles in width (embracing groves of timber), which extends across the State of Indiana from west to east. Immediately south of this, there is a belt of wood-land, to which succeeds the valley of the Kankakee, with its deep and sluggish waters, bordered on both sides with extensive marshes, having a grassy surface. Thus, the people who inhabit the prairie to the north or leeward, are subjected to influences which, in the latitude of  $41^{\circ} 30'$ , and at the elevation of six or seven hundred feet, give rise to a great deal of autumnal fever.

Michigan City is situate within the tract here described, on the west side of the mouth of a small stream called Trail Creek, in N. Lat. (about)  $41^{\circ} 47'$ , on a sandy plain which rises but a few feet above the surface of the lake. In its rear are sand hills and then a marsh. From Doctor Pulford I

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\* From the late William Harris, Land Surveyor.

learned, that autumnal fever, both intermittent and remittent, prevails here in a decided and often dangerous degree.

IX. LAPONTE.—This town stands within the district just described, ten miles south of Michigan City. The lagging Kankakee, with its vast marshy bottoms, comes within ten miles of it on the south side. The country around the town is level, and composed of diluvium or drift, supporting bowlders, like the whole region adjacent to the lake. It is partitioned, with some equality, between prairies, barrens, or open woods, and dense forests. As Laporte is situate on the summit-level between the St. Lawrence and the Mexican basins, it has no streams larger than rivulets near it; but there are several small lakes, with sandy shores, some of which are so shallow, as to abound in aquatic plants.

According to Doctor Andrew, from whom I have borrowed these facts,\* the settlement of Laporte was commenced in 1831, but no autumnal fever occurred until 1838, when it appeared as an epidemic intermittent, and recurred, with diminished violence and extent of invasion, in the two following autumns. Of the reasons why, for the first seven years of its settlement, the town should not have suffered from this fever, and should then have been invaded, I cannot speak.

X. EASTERN COAST OF LAKE MICHIGAN.—The country east of Lake Michigan constitutes a peninsula, which is bounded on the east by the western end of Lake Erie, Detroit River, the River St. Clair, and Lake Huron. Through this peninsula, from north north-east to south south-west, there runs a swell, which rises from two to six hundred feet above the surrounding waters, and supports a countless number of small transparent and permanent lakes; which give origin to rivers that flow to the east and west. Those which take the latter direction offer themselves to our notice in this place. The first and most southern is the St. Joseph, which, originating in the State of Michigan, bends through the north-east corner of Indiana, reënters the state in which it began, and flows into the lake at the town of St. Joseph's. The next in size and southern latitude, is the Kalamazoo, which, originating in the same water-shed, makes its way directly to the lake. The third is Grand River, which, having a similar origin and termination, lies a little further north. The fourth, and last that I shall mention, is the Muskegon, which, from a lacustrine source on the same high lands, enters the lake a little north of the last. These rivers drain the south-west corner of the State of Michigan; which region embraces many interesting towns and settlements; but not having visited it, nor met with any account of its medical topography, I am compelled to dismiss it with this notice.

North of the river Muskegon, up to the vortex of the peninsula at the straits of Mackinac, between the forty-third and the forty-sixth parallels, the rigors of the climate have retarded the settlement of the lake shores, and its medical topography has not been studied; but it is known to abound in small lakes.† On this coast there are two deep narrow bays, called by the

\* Western Lancet, Vol. VII, No. 3.

† Michigan Geological Reports.

*voyageurs* Grant and Little Traverse, on which there are missionary stations among the Indians. Their latitude is about  $45^{\circ} 30'$ . I was told at Mackinac, that the natives at these establishments are sometimes affected with both intermittent and remittent fever; but the number of cases is small.

## SECTION V.

### BASIN OF LAKE HURON.

I. OUTLINES. — Lake Huron, as we have already seen, is connected with Lake Superior by the Straits or River called the St. Mary, and with Lake Michigan, by the Straits of Mackinac. It lies south-east of the former, and east north-east of the latter. Its northern border falls between the forty-sixth and forty-seventh parallels, its southern extremity reaches the forty-third. Its area is estimated at twenty thousand four hundred square miles; its elevation above the sea is five hundred and seventy-eight feet; its mean depth one thousand; its greatest depth,—off the mouth of Saginaw Bay,—eighteen hundred or two thousand feet.\* A long range of islands, called the Manitoulins, running nearly parallel to its axis, gives to its upper or northern portion, an interior or insular coast. Beyond these islands, there are large bays, of which the most extensive has received the name of Georgian. On that side of the Lake, there are, as yet, no settlements deserving the attention of the medical topographer, until we descend to the country south of the bay just mentioned, between the forty-fourth and forty-fifth degrees of latitude, in Canada West. On the opposite or south-west side of the lake, in the State of Michigan, the country is, likewise, in a great degree unsettled, until we arrive at Saginaw Bay, near the forty-fourth parallel. To the north and north-east, the Huron Basin is bounded by the water-shed of the St. Lawrence and Hudson Basins; to the east and south-east, by the dividing lands between it and Lake Erie and Lake Ontario; to the west, by the highlands which traverse the lower peninsula of Michigan, already noticed. In the south, Lake Huron narrows to a strait, through which its superabundant waters flow off toward Lake Erie. In a voyage from Mackinac to this outlet, on the 9th of August, 1842, when the surface-temperature was probably at its maximum, I found the following variations:

Harbor of Mackinac,	-	-	-	-	-	62°.5
Ten or twelve miles out,	-	-	-	-	-	61°.
Middle portions of the lake,	-	-	-	-	-	58°.
" " "	-	-	-	-	-	54°.
" " "	-	-	-	-	-	54°.
In sight of land, Canada shore,	-	-	-	-	-	50°.
" " Michigan shore,	-	-	-	-	-	61°.
Ten miles from Michigan shore,	-	-	-	-	-	61°.
Near the outlet of the lake,	-	-	-	-	-	63°.

\* Michigan Geological Reports.



Here, as on Lake Michigan, we find the surface-temperature less as the depth of water is greater.

II. MACKINAC.—This is at once the name of an island, a strait, a village, and a fort; as may be seen by inspecting *Pl. XIV*; on which the height of the island above the water is marked correctly, two hundred and nineteen feet, and the latitudes and longitudes are, approximately, stated at  $45^{\circ} 51' N.$ , and  $85^{\circ} 5' W.$  The island lies a little east of the straits, and therefore belongs to Lake Huron, rather than Lake Michigan. Rising boldly out of the water, it is not fringed with the green marshes, so often seen on the lake margins. Geologically, it is a mass of sub-carboniferous, Devonian or upper Silurian limestone, with the external surface in a state of decay. In some places its escarpments are nearly perpendicular, in others they slope gently down to the lake. On the south side is the harbor, presenting a crescent-indentation, with a beach of limestone pebbles, blanched by the alternate action of the air and water. The latter is so transparent, that the pebbles may be distinctly seen at the depth of many feet. This beach terminates in a low but dry plain, on which stands the village of Mackinac, with the fort in its rear and one hundred and fifty feet above it. The higher—which are the south-eastern—portions of the island, are rocky; but whatever soil has accumulated from the decay of the limestone rocks, is fertile. The opposite end is lower, and has a deeper covering of soil; but the surface is overspread with a countless number of large primitive boulders. A portion of the gentle slopes of the island is cultivated. Much of the original forest, composed largely of sugar maple and paper birch, is still standing.

The temperature of the water on the lake shore, where shallow, I found, in the month of August, to be  $82^{\circ}$  Fahrenheit;—where deep,  $50^{\circ}$ , both at the surface and two hundred feet below. A spring, which bursts out near the bottom of the bold eastern escarpment, had, at the same time, the temperature of  $44^{\circ}$  Fahrenheit.

From this description it appears, that the conditions which are held to be necessary to the generation of autumnal fever, are at their *minimum* on this island; and, when we connect this fact with its latitude,—nearly  $46^{\circ}$ ,—and its altitude above the sea,—from six to eight hundred feet,—we are prepared to find it almost exempt from that disease; and such, from the testimony of its inhabitants, is the fact; especially in reference to the intermittent form, which, I was assured by many respectable persons, never originated among the people of the town, and would cease spontaneously in those who returned or came with it from other places. Doctor Rankin, however, who had resided four years in the village, had met, in autumn, with a few remittents, which tended to a continued form. But we must not overlook the army returns, from the post which has long been maintained on this island.

According to those returns,\* the ratio of remittent fever is one per cent. per

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\* Medical Statistics U. S. A., p. 74.

## MACKINAC

Depth 41 fathoms  
 100 fathoms 120 fathoms  
 140 fathoms 160 fathoms

Scale 1/2 inch to 1 mile

ISLAND OF MACKINAC

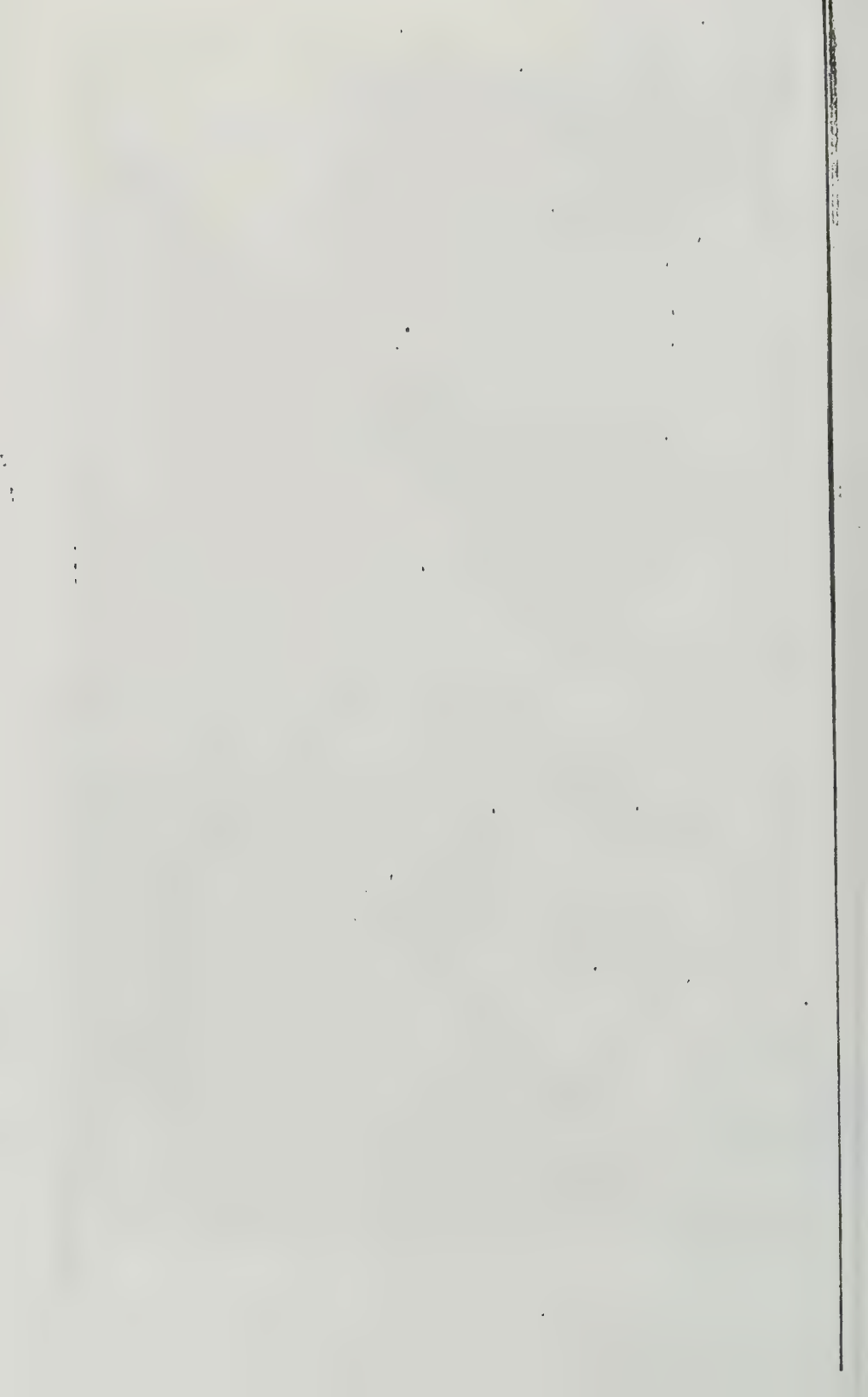
STRAIT OF  
 MACKINAC

LAKE HURON

## References.

1. Town of Mackinac
2. Fort Mackinac
3. Site of St. Ignace
4. Ojibwa Reservation

LAKE  
 MICHIGAN





annum; of intermittents, eight. The latter ratio seems to invalidate the assertion, that intermittent fever is nearly unknown here, and requires to be examined. During the period embraced in the returns, there were sixty-five cases reported, of which seven were in the first quarter of the calendar year, thirty-one in the second, thirteen in the third, and fourteen in the fourth. Now, in the climate of that post, no new case can be generated within the first and second quarters, and consequently, of the sixty-five cases, thirty-eight must be regarded as relapses, or as vernal intermittents, depending on a morbid impression made on the system the preceding autumn. Still further, of the fourteen cases in the fourth quarter, we may suppose a proportion, equal to that of the first quarter, to be of the same kind; for the cause of the disease could not be in existence in the months of November and December; we may, then, subtract five from the returns for that quarter, and place them with those for winter and spring, raising that column to forty-three, and, consequently, leaving but twenty-two cases of summer intermittent, for the whole period. It cannot be said that the vernal intermittents were of those who had contracted the disease on the island in the preceding summers and autumns, for a part only of those who suffer in the latter seasons, relapse in the spring; but here the number of vernal cases was greater than the whole number of autumnal.

It seems to result, then, from what has been said, that at least two-thirds of the cases at Fort Mackinac must have been contracted elsewhere; reducing the number of (possibly) original cases, to less than three per cent., with a probability that even these might have resulted from the previous notion of the remote cause at some more southern and sickly post. Doctor Forry, the editor of the Army Medical Statistics, thinks it difficult to explain why the second quarter of the year presented twice as many cases as the third; but what has been said, perhaps accounts for it; while it reconciles the garrison returns with the popular opinion, that intermittent fever is not among the endemic diseases of the island.

III. SUMMER VOYAGES ON UPPER LAKES, WITH A RESIDENCE AT MACKINAC, FOR INVALIDS. — The three great reservoirs of clear and cold water — Lakes Huron, Michigan, and Superior, with the Island of Mackinac in their hydrographical center — offer a delightful hot-weather asylum to all invalids, who need an escape from crowded cities, paludal exhalations, sultry climates, and officious medication. Lake Erie lies too far south, and is bordered with too many swamps, to be included in the salutiferous group. The voyage from Buffalo, Cleveland, or Sandusky, on that lake, or from Chicago or Milwaukee, on Lake Michigan, may afford, should the water be agitated, all the benefits of sea-sickness, without its tedious prolongation. On reaching Mackinac, an agreeable change of climate is at once experienced; and the bodily feeling is heightened, by the emotions which the evidence and consciousness of having retreated upon an island, raise in the mind of one who has not before enjoyed the novelty of an insular life. To his jaded sensibilities, all around him is fresh and refreshing; a feeling of security comes over him, and when, from the rocky battlements of Fort Mackinac, he looks down upon

the surrounding waters, they seem a mont of defenso against the host of annoyances from which he had sought a refuge. Thus a curative stato of mind begins to act on his body, from the momont of his landing; and, if he be a person of intelligence and taste, this salutary mental exoltomont will not soon die away; for the historic associations, not less than the scenery of this island, are well fitted to maintain it.

The first white men who dwelt on Mackinac, and the surrounding coasts, were the French ecclesiastics and fur-traders. In 1708, the whole passed, with Canada, to the jurisdiction of Great Britain; by whom, in 1790, it was surrendered to the United States. In 1812, it was conquered by that power, and restored at the close of the war. From the summit of the island, the eye rests upon a number of spots consecrated to military history. But the natural scenery is still better fitted to make the invalid forget his ailments. Several agreeable and exciting boat voyagos may be made to the neighboring coasts, from each of which a new aspect may be had; and the island itself, although but nine miles in circuit, affords opportunities for a great variety of rambling on foot. In these excursions he may ascend to the apex of the island, once the site of a fort. From this summit, elevated far above all that surrounds it, the panorama is such as would justify the epithet to Mackinac—Queen of the Isles. To the west, are the indented shores of the upper peninsula of Michigan; to the south, those of the lower, presenting, in the interior, a distant and smoky line of elevated table-land; up the straits, green islets may be seen peeping above the waters; directly in front of the harbor, Round Island forms a beautiful foreground; while the larger *Dois Marie*, with its light-house, stretches off to the east; and to the north are other islands, at varying distances, which complete the archipelago.

When the observer directs his eye upon the waters more than the land, and the day is fair, with moderate wind, he finds the surface as variable in its tints, as if clothed in a robe of changeable silk. Green and blue are the governing hues, but they flow into each other with such facility and frequency, that while still contemplating a particular spot, it seems, as if by magic, transformed into another; but these mid-day beauties vanish before those of the setting sun, when the boundless horizon of lake and land seems girt around with a fiery zone of clouds, and the brilliant drapery of the skies paints itself upon the surface of the waters. Brief as they are beautiful, these evening glories, like spirits of the air, quickly pass away; and the gray mantle of night warns the beholder to depart for the village, while he may yet make his way along a narrow and rocky path, beset with tufts of prickly juniper. Having refreshed himself for an hour, he may stroll out upon the bench, and listen to the serenade of the waters. Wave after wave will break at his feet, over the white pebbles, and return as limpid as it came. Up the straits, he will see the evening star dancing on the ruffled surface, and the loose sails of the lagging schooner flapping in the fitful land-breeze; while the Milky Way — DEATH'S PATH of the red man — will dimly appear in the waters before him. Behind, in the street, a lively group of Canadian French, of every shade of color between white and red, will gossip and shrug their

shoulders; on one side, should the Indians, who still inhabit the shores of Lake Michigan, be on a visit to the island, he will hear the uproar of a lodge of drunken Chippewas, with the screams of women and children, and the cackling of frightened hens; on the other, will see the sober and listless Ottowa, sitting in silent vacancy of thought, on his upturned birch canoe, his wife within the tent, spreading cypress bark and fag mats upon the gravel, as lodgings for the night; while half a dozen children loiter or play about the door, and as many half-starved dogs curl up among them. Surrounded by such scenes, the traveler begins to realize that he is a stranger; when, suddenly, a new phenomenon appears, and fixes the conviction. Every object becomes more visible; and, raising his eyes, he beholds the heavens illuminated with an aurora borealis, where he reads in fantastic characters of strango and eccentric light, that he is, indeed, a sojourner in a strango land, and has wandered far from his friends and home, in the sunny regions of the south.\*

While the valetudinarian, during the summer months, makes the island of Mackinac his home, he may enjoy several interesting steamboat voyages. At any time, he can descend to Detroit and Niagara; or, passing through the straits of Mackinac, visit Chicago, Racine, and Milwaukee, on the western coast of Lake Michigan. Opportunities will likewise be presented, to ascend the St. Mary to the *Sault*, where he will find much to interest him; and whence he may proceed, in a fur-trading skiff, or a bark canoe, to Gros Cap, at the efflux of the river from Lake Superior. Finally, he may have it in his power to embark on that lake, and visit the copper hills of the mineral region near its southern shore; the climate of which is represented as highly invigorating; while the novelty and wildness of the scenery will act with salutary influence on his imagination and feelings.

Those who are prone to consumption, might, perhaps, experience some injury from the humidity of this lacustrine region; to hypochondriacs, dyspeptics, chlorotics, and all who have their constitutions broken down by autumnal fever, it must, however, prove ominantly restorative.

IV. DRUMMOND'S ISLAND.—In leaving Mackinac, we shall proceed down Lake Huron, on its northern and eastern shore, which, it will be recollected, lies in Canada West. The large island with which we begin, called Drummond's Island, is the most western of the Manitoulin Chain, and lies immediately east of the mouth of St. Mary's River, in latitude 46°. The British once had a fort upon it, near which there were extensive marshy shores, but autumnal fever was almost, if not entirely, unknown.†

V. PENETANGUISHINE.—This village, of one hundred and twenty inhabitants, chiefly French and Indian half-breeds, is the seat of a small naval and military establishment.‡ It stands on the southern shore of Georgian Bay, in N. lat. about 44° 45', at the base of a long sandy ridge two or three

\* The Northern Lakes a Summer Residence for Invalids of the South. By Daniel Drake, M.D.: 1842.

† Tulloch's Statistical Reports of the British Army.

‡ Smith's Canadian Gazetteer.



hundred feet high, which projects into the bay. At the head of the bay, and for several miles south-east, there are low swampy grounds, between which and the barracks, however, a hill intervenes. The surrounding country is undulating or hilly, and generally covered with woods. In 1828, the troops were transferred to this post from Drummond's Island. It has proved to be as free from autumnal fever as that island. That fever, in fact, is nearly unknown.\*

VI. COUNTRY AROUND GEORGIAN BAY.—On the north and north-east of Georgian Bay, to the water-shed between the St. Lawrence and Hudson Basins, the country is wild and dreary, abounds in small lakes, and remains unsettled. The region around the bottom or southern extremity of the bay, in the rear of Penetanguishine, extending to within forty miles of the head of Lake Ontario, includes the large and beautiful Lake Simcoe; which, by a descent of one hundred and seventy feet, and a circuitous route to the north, discharges its superfluous waters into Georgian Bay, through the Severn River. The region to the south-west of this river, between the bay and lake, as well as that drained by all the rivers which fall into both, is covered with excellent soil, and has a considerable, though scattered, population.† The surface is generally wet and in many places marshy, but in the latitude of  $44^{\circ}$  or  $45^{\circ}$ , such a condition produces but little autumnal fever. Its medical history, however, has not been written.

VII. LOWER EASTERN SHORE OF LAKE HURON.—Most of the cape between Georgian Bay and Lake Huron, is unsettled Indian country; and it is not until we descend below the latitude of  $44^{\circ}$ , that we come into a region of interest to the medical etiologist. There, we reach the Huron District, which extends nearly to the southern extremity of the lake, and has a considerable population, composed almost entirely of immigrants from Europe. The district includes a swamp of vast extent. The principal town of the district is *Goderich*, on the shore of Lake Huron, at the mouth of Maitland River, about N. Lat.  $43^{\circ} 45'$ . It stands on a dry surface, one hundred feet above the lake.‡ According to Doctor Stratton,|| autumnal fever is rarely seen at this place. Of the medical topography of the district generally, and the prevalence of fever in autumn, I can say nothing further.

VIII. WESTERN SHORE OF LAKE HURON, AROUND AND SOUTH OF SAGINAW BAY.—This bay projects to the south-west, from the western or Michigan side of the lake. Its extreme point, in Saginaw county, receives the waters of Saginaw River, which originates within the coal basin which occupies the center of the lower or southern peninsula of the State of Michigan. This is the most considerable tributary of the western side of Lake Huron. There are considerable settlements within this basin, but nothing has been published on its medical topography. There was a military post at the head of the estuary of Saginaw River, at which, as Doctor Pitcher, now of Detroit, has informed me, autumnal fever prevailed, and sometimes assumed a malignant character. The latitude of the post was about  $43^{\circ} 20' N$ . From

\* Tulloch.

† Smith's Canadian Gazetteer.

‡ Smith's Canadian Gazetteer.

|| Edinburgh Medical and Surgical Journal, No. 161.

*Point aux Barques*, immediately below Saginaw Bay, down to the terminating extremity of the lake, the coast is nearly straight, with but few indentations, and presents low cliffs of sandstone, emerging from under the coal basin of the interior of Michigan; while the coast above the bay shows cliffs of upper Silurian limestone, which have risen from beneath the sandstone. This lower coast, and the country in its rear, are but sparsely peopled, and I know nothing of its special medical topography or autumnal diseases.

## SECTION VI.

### STRAITS BETWEEN LAKE HURON AND LAKE ERIE: LAKE ST. CLAIR.

I. **THE STRAITS.**—These straits have received two names. The portion which extends from Huron to the little Lake St. Clair, is called St. Clair River; that which extends from the southern side of that small body of water, to the west end of Lake Erie, is the well-known Detroit River. The fall in the two is fourteen feet. Both the upper and lower portions are bounded by banks of post-tertiary or diluvial clay, supporting heavy forests, wherever settlements have not been made. The current of this broad and deep natural canal, except where the water issues from Lake Huron, is gentle; its width is from one to two miles. St. Clair River is about forty miles long—Detroit River, twenty-three or twenty-four. The banks of the upper part of St. Clair River are well-developed; but as it approaches Lake St. Clair they sink, and its shores become more or less marshy. The upper part of Detroit River has banks sufficiently high; but as we descend, wet or swampy grass flats appear on each side of the river.

II. **THE LAKE.**—This little intermediate sheet of water has a mean length and breadth of twenty and eighteen miles; an area of three hundred and sixty square miles; a mean depth of twenty feet; and an elevation of five hundred and seventy feet above the sea,—being in that respect intermediate between Lakes Erie and Huron. The silt thrown into St. Clair River by its tributaries, is deposited at the head of Lake St. Clair, where alluvial islands are continually forming. St. Clair River, in fact, has a delta, that is regularly advancing into the lake,\* which, from this source and the rivers which open into it laterally, will ultimately be converted into a marsh, with a river running through it. Much of the land around it is low and swampy; and there are, also, large savannas, so dry as to form natural grazing lands, and even to admit of cultivation, which are inundated by the periodical rises to which the lakes are subject.† In the month of August, I found the surface-temperature of this shallow lake, to be from 60° to 71°, according to its depth. In winter it is entirely bridged over with thick and firm ice, which has become an article of exportation to Cincinnati.

III. **HEAD OF THE STRAITS: FORT GRATIOT: FORT HURON: FORT SARINIA.**—The efflux of St. Clair Strait or River from Lake Huron, is in a loca-

\* Michigan Geological Reports.

† Smith's Canadian Gazetteer.

lity of some interest to the medical historian. Its latitude is  $43^{\circ}$  N., its longitude  $82^{\circ} 10'$  W. The height of the banks may be taken at six hundred feet above the sea. Within this locality, there is the *embouchure* of Black River, with Fort Gratiot and the town of Port Huron, on the Michigan side, and the town of Port Sarnia, with an Indian village, on the Canada side. Fort Gratiot stands on a sand-dune, very near the point of exit of the waters of the lake, and Port Huron on the same dune, a mile below, at the mouth of Black River.

The sources of this river are in tamarack swamps, not far from the western shore of Lake Huron, nearly parallel to which shore it flows on until within a few miles west of Port Huron, when it turns to the eastward and joins St. Clair River at that town. Its water, like that of many other streams having a similar origin, has the color of ink liberally diluted, which seems to be produced, either by some exclusively vegetable coloring-matter of the swamps, or by the tanno-gallate of iron, formed by the union of the appropriate acid (supplied by the tamarack pine) with the metal, in which the soil of that part of Michigan abounds. Black River, as it approaches the St. Clair, lies immediately to the west or windward of Fort Gratiot and Port Huron, at a distance varying from a few hundred yards to a mile, without any intervening hills, while its bottoms are broad and swampy, and its own current checked by a mill-dam near its mouth. Between the two rivers, is the sand-dune of which I have spoken, with its little pools, or wet basins, in which the recrement of plants have been decomposed into soil. The western or right bank of the river is higher, and consists of compact post-tertiary clay, with pebbles. Opposite the fort and village, the St. Clair is fringed with a narrow belt of low alluvial bottom, on which rain-water stands in little ponds, or forms small marshes, and over which the river flows in the periodical rises of the lake.

FORT GRATIOT. — The returns from Fort Gratiot\* show a decided prevalence of intermittent fevers; the annual ratio being seventy-two per cent; that of remittent fever is, however, only three per cent. When we compare the relative prevalence of these two forms of fever at this post, with their prevalence at Fort Crawford, in the same latitude, on the banks of the Mississippi, we find that, while intermittent fever is more prevalent here, remittent fever is more prevalent there. Here, the latter makes but three or four per cent. of all the cases of autumnal fever; there, it makes fourteen per cent., and is, therefore, four times as prevalent, compared with the intermittent form. When we bring Fort Snelling, on the Mississippi, in N. Lat.  $44^{\circ} 53'$ , into this comparison, the conclusion is strengthened; for, at that post remittents make thirty-three per cent. of the whole. These facts are instructive. A long river-beach low-water marsh lies to the windward of Fort Crawford, and the swampy mouth of the St. Peter's in the same direction from Fort Snelling; but the amount of watery surface around those spots, in autumn, is small, compared with that around Fort Gratiot, which has the

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\* Medical Statistics of United States Army.



lake on its north, the St. Clair on its east, and Black River, with a dam and pond, on its south and west. The atmospheric humidity of this little peninsula is, therefore, very great, compared with the sites of Fort Crawford and Fort Snelling, and to this meteorological condition, we must I think, ascribe its greater proportion of intermittents compared with remittents. Doctor Ferry, the ingenious editor of our army statistics, has compared this post with Mackinac, and ascribed the difference in autumnal fever to topographical causes. It results, however, in part from the higher latitude and elevation of Fort Mackinac; as the comparative absence of that fever at Fort Howard and Fort Winnebago, places south of Mackinac, but north of Gratiot, and with topographical conditions similar to those of the last, sufficiently proves. The forty-third parallel, with an elevation of six hundred feet above the sea, is, in fact, very near the highest latitude, at which, from the Mississippi eastwardly to St. Clair River, autumnal fever appears in an epidemic form. Beyond that degree, it rapidly diminishes, and in the forty-sixth is nearly unknown as an original disease. At a lower level, the line of epidemic prevalence will, of course, be found farther north.

*Port Huron.* — To return to our present locality, I may state, that the people of the village of Port Huron, as I learned from the resident physician, Doctor Noble, and from Doctor Southgate, the post surgeon, are as subject to autumnal fever as the troops; and the settlers on the banks of the St. Clair, below the town, likewise suffer from the same disease.

*Port Sarnia.* — This Canadian village stands on the east bank of St. Clair River, opposite Port Huron. Above it, the low cape, Point Edwards, narrows the outlet of the lake to half the width of the river, in front of Port Sarnia, and establishes, opposite and above that village, a miniature bay of shallow water, abounding in aquatic grasses. The site of the town, is a sufficiently elevated terrace of post-tertiary clay and gravel, or hard pan, identical in character with that immediately below the mouth of Black River. This plain is overspread with lofty forest trees. On the river bank, south of the village, there is a permanent settlement of Chippewa Indians. The inhabitants of Sarnia, and its vicinity, are subject to autumnal fever;\* but whether more or less so than those of Port Huron, I cannot say.

VI. *ADJOINING PARTS OF CANADA.* — The western bank or peninsula of Upper Canada, in which Port Sarnia lies, is bounded on the north by the lower end of Lake Huron, on the south by Lake Erie, and on the west by St. Clair River, Lake St. Clair, and Detroit River. In the civil divisions of Canada, it constitutes the Western district. Its principal river is the Thames, which, traversing it from east to west, opens into Lake St. Clair. The next in size is Bear Creek or Sydenham River, composed of two forks, the north and the east, which drain the country, in the rear of Port Sarnia, and throw their united waters into the Delta of St. Clair River.

The Thames, which is one hundred and fifty miles in length, originates in Brook and Huron districts, where, by its southern branch, it interlocks with

\* From W. Jones, Esq., Assistant Superintendent Indian Department.

tributaries of Grand River, whose waters fall into the eastern end of Lake Erie. From these origins, the Thames traverses London district, and, lastly, the Western district, in which it joins Lake St. Clair. The town of London is situated at the junction of its two principal branches. The basins of the Thames and the Sydenham, comprehend the best portions of Canada West. In the interior, the surface is rolling, in some places hilly;—but there are also tracts of swamp, and the streams have alluvial bottoms, many of which are subject to inundation. Advancing toward Lake St. Clair, the country becomes more level, the wet savannas multiply, and the low river-bottoms acquire greater breadth. The mouth of the Thames is in N. Lat.  $42^{\circ} 20'$ ,—its northern sources in  $43^{\circ} 20'$ . Every part of the region drained by this river, and also of that drained by the Sydenham, is liable to autumnal fever; but the lower or western, much more than the interior, which is dryer and a little farther north. The insalubrity of many localities in the Western district has retarded their settlement. I cannot say whether the old settlements of Canadian French, on the banks of the Thames, suffer as much as the recent immigrants from Europe and the United States.\*

VII. SANDWICH.—This village stands on the east bank of Detroit River, nine miles below Lake St. Clair, and three below the city of Detroit. It is one of the oldest French settlements in Canada West, and many of its inhabitants are still of that race. It has, at times, been the seat of a military post. It is built on a sloping gravelly bank; but there are marshes around it, over the surface of which Doctor Stratton has often seen, in the morning and evening, a thin stratum of dark-colored air, perceiving, at the same time, an offensive smell, and experiencing, at the latter hour, a peculiar sensation of heat; an observation made by others beside himself. The inhabitants are subject to autumnal fever; and during the time that two companies of troops were in barracks there, half of them were often ill, at once, with that disease.

Windsor, a small village, two miles north of Sandwich, is situated on a high bank of Detroit River, and enjoys an exemption from creeks and marshes. A body of colonial militia stationed there, remained healthy in summer and autumn.†

VIII. AMHERSTBURG AND MALDEN.—The extreme south-west point of Canada West, is the township of Malden, at the junction of Detroit River with Lake Erie. It comprehends the town of Amherstburg, and a permanent military post called Fort Malden. It was settled long since by Canadian French, but contains many English, Scotch, Irish, and American immigrants, with a large negro population, from the United States. Its soil is extremely fertile.‡

Amherstburg rests on Detroit River, about a mile from the lake, and Fort

\* Smith's Canadian Gazetteer. — Doctor Stratton, in Ed. Med. and Surg. Journal. — Martin's History of the British Colonies.

† Stratton, Ed. Medical and Surgical Journal, No. 147.

‡ Smith's Canadian Gazetteer.

Malden stands half a mile above the town, in N. Lat.  $42^{\circ} 36'$ , and W. Lon.  $82^{\circ} 56'$ . About half the surrounding country is in woods. The vicinity of the town is flat, and there are several extensive marshes; there is, also, a creek hard by, the banks of which are overflowed by freshets in Detroit River, and much of the water left to evaporate. Around the fort there is a ditch, containing stagnant water. The troops in Fort Malden have always been afflicted with autumnal fever, both intermittent and remittent; and, throughout the summer and autumn, most families of the village have, successively, a member down with it. In the winter of 1839 and 1840, Doctor Stratton saw a few cases (*quere*, *relapses?*) before the 17th of February, when there came a thaw, which floated off the ice that had buried up the muddy banks of Detroit River, and "the next morning several persons, living in houses along the bank, were attacked with ague."\*

IX. DETROIT. — There is no considerable town or river between Port Huron and the city of Detroit, standing on the right or Michigan side of the straits. Much of the bank around and below Lake St. Clair, has long been settled by Canadian French, and, in its elevation above the surface of the river, as well as the style of domestic and agricultural improvement, it resembles the '*Coast*' in Louisiana.

Detroit is built in N. Lat.  $42^{\circ} 20'$ , and W. Lon.  $82^{\circ} 58'$ , about six miles below Lake St. Clair, on a post-tertiary clay plain, which stretches many miles into the interior. Its elevation is from twenty to thirty feet above the surface of the river. To its north-east, at the distance of a mile, a small stream, named Bloody Run, and then another, called Comer's Creek, enter Detroit River; above which, at the exit of the river from Lake St. Clair, there is an extensive marsh. At the distance of three miles below the city, opposite Sandwich, the bluff banks recede, and green marshes are developed on both sides of the river. Through these marshes, at the distance of five miles from Detroit, the small river Rouge, a foul and sluggish stream, with swampy alluvions, makes its way from the west to Detroit River. The level country back of the city abounds in marshes, swales, and pent bogs; but the suburbs are not infested. The ground on which the city stands, however, is too level to permit good drainage, and too clayey to favor percolation; it is therefore, in spring and autumn, so wet that board pavements are preferred to brick. Well-water can be obtained by digging into the argillaceous plain, which, at the depth of a hundred feet or more, rests on the upper Silurian limestone. The city, however, is supplied with river-water by a steam engine and pump.

The condition of the opposite bank, on which stands the hamlet of Windsor, has been already mentioned. From this sketch it appears, that the ancient metropolis of the upper lakes, is neither greatly exposed to, nor exempt from, those topographical circumstances, which give rise to autumnal fever; the prevalence of which harmonizes with the topography. Of the degree in

\* Ed. Medical and Surgical Journal, No. 147. — Tulloch's Statistics of the British Army. — Smith's Canadian Gazetteer.



which that fever prevailed among the French, who, in 1701, began the settlement of Detroit, under the name of Fort Pontchartrain, we have no record. At this time, the site of the city and its environs must be regarded as a surface long broken up and exposed to the action of the sun and rains; which, it is well known, at last destroys some of the topographical causes of autumnal fever. Still, as I learned from Doctor Pitcher and Doctor Potter, intermittent and remittent fevers occur every autumn, both in the city and its suburbs, and occasionally assume a malignant type.

X. BASINS OF THE ROUGE AND HURON RIVERS.—These small rivers, of which the latter is the larger, drain the country in the rear of Detroit. The Rouge, as we have already seen, joins the straits five miles below the city; the Huron pours its waters into the north-west corner of Lake Erie, a few miles below Amherstburg, on the opposite side of the estuary of Detroit River. The general course of both the Rouge and Huron is to the south-east, and thus their middle and upper waters lie to the west of the city of Detroit. Their sources are in several small lakes, at an elevation of about one hundred and fifty feet above the Detroit plain, from which they descend with a rapid current, to traverse the broad and flat surface of Wayne county, which extends from Lake St. Clair to Lake Erie. Within this tract, their currents, and those of all the smaller streams, are sluggish. About one-third of Wayne county is composed of undulating oak plains, more or less sandy, and interspersed with wet grassy prairies; while two-thirds consist of flat heavily timbered lands, abounding in marshes. From Lake St. Clair down to Huron River, at the distance of a few miles back from Detroit River, there extends a slip, three or four miles wide, which is depressed below the general level, and is either wet or swampy. South of the Rouge, between it and the Huron, this belt presents extensive wet prairies. The rivers and smaller streams which traverse it, having but little current, overspread it in their freshets to a large extent. This tract of low grassy surface, in fact widens toward the mouths of those rivers. The region we are now describing, is composed of a deep upper stratum of post-tertiary clay, covered with rich soil, and resting on Silurian limestone; which rock, as we advance into the interior, shows itself, here and there, through its argillaceous covering.\*

*Township of Plymouth.*—Doctor Sprague† has written a paper on the topography and diseases of the north-west township of Wayne county, watered by the upper streams of the west branch of the river Rouge. The north half of the township is hilly, and covered with forest; the other half level, and partly timbered. Mill-ponds abound, and one of them, with its vicinity, is thus described: "The pond is located in a valley, which is formed by the rising of two banks to the height of fifty or sixty feet. The greatest distance between them is forty or fifty rods, most of which is occupied by the pond, which contains a great deal of decaying vegetable matter, both

\* Michigan Geological Reports.—Gazetteer of the State of Michigan.

† Western Lancet, Vol. IV, No. 7.

lignous and herbaceous. From the western bank, another terrace, densely covered with trees, arises." Between the first bank on that side and the pond, upon a small area, rising but ten feet above the latter, there resided seven families, into one of which, in the month of August, 1843, Doctor Sprague was called to treat a case of simple intermittent, and for the next five weeks, generally had from eight to twelve patients in this little community. Meanwhile the health of the surrounding country was good, save a family here and there, residing near some other pond. In the ensuing summer, the dysentery prevailed in many parts of the township; but, with the exception of a single case, passed by the pond settlement; which, however, suffered again from autumnal fever. As a general fact, Doctor Sprague remarked, that intermittent and remittent fevers prevail, for five or six weeks every year, in and around the ponds and marshes of this part of Michigan. The latitude of this region is 42° 30' N.

From *Dearbornville*, where the river Rouge receives the waters of its west branch, down to Detroit River, its current lags, and its banks are low and wet. It was originally settled by Canadian French, who have, as the late scientific and indefatigable Doctor Houghton informed me, at all times suffered severely from autumnal fever. As this shallow valley lies from five to ten miles to the windward of Detroit, without any intervening hill or extensive forest, it may be one source of the fevers which occur in that city.

In making a railroad trip from Detroit to Ann Arbor, I observed that the surface of the country, out to the Rouge near Dearbornville—a distance of ten miles—was flat, and in many places marshy, with heavy forests. The Rouge, where the road crosses, was sluggish, with a foul aspect.

*Ann Arbor* is built on Huron River, forty miles west of Detroit. The larger and better part of the town is on the western bank, which presents two terraces, a lower and a higher. On each side of the stream, there is a narrow slip of alluvial bottom, liable to inundation when the river is high. The University of Michigan stands half a mile west of the river, on the upper terrace. From Doctor Denton, who had resided seventeen years at this place, I learned that its inhabitants had suffered from autumnal fever, in common with those near the river, above and below the town. The same gentleman had also observed that the people who reside on the left-hand or leeward bank of the river, suffer more than those of the opposite or southwest side. By his narrative of symptoms, I discovered that cases as malignant or congestive as any in the south, occasionally occur.

*First Plowings.*—Doctor Denton, and Doctor Houghton, the naturalist of the University, assured me, that they had seen many examples of the influence of the first plowing up of new lands, both prairie and forest, in the production of autumnal fever. Even the breaking up of dry gravelly soils had been followed by fever.

## CHAPTER XIII.

THE EASTERN OR ST. LAWRENCE BASIN,  
CONTINUED.

## BASIN OF LAKE ERIE.

ERIE, the last and most southern of the Upper Lakes, receives, through Detroit River, the overflowings of Lakes Superior, Michigan, and Huron, which enter its western extremity, and are discharged, with its own superabundant waters, from its eastern, by the Niagara River. Their ingress is just above the forty-second parallel—their egress, a little below the forty-third; the distance between those points being about four degrees of longitude, that is, from the seventy-ninth to the eighty-third. Lake Erie, like Lake Michigan, is a long narrow body of water, with an axis running nearly east north-east and west south-west. Its form is that of a compressed oval, indented on the north side, and elongated to a beak at its eastern extremity. Its mean length is two hundred and forty miles; its mean breadth, forty or fifty miles; its mean depth, eighty to ninety feet; and its elevation above the sea five hundred and sixty-four or sixty-five feet.\* The shallowness of this lake, compared with those above it, constitutes, perhaps, its greatest point of difference from them; and is such, that strong winds agitate it to the bottom, and render its waters more or less turbid, according to their depth. On its north or Canadian side, the basin of Lake Erie is of such limited extent, that all the tributaries it supplies, except Grand River, which enters near the eastern extremity of the lake, are of insignificant size. This results from the manner in which it is overlapped at each end, respectively, by Lake Huron and Lake Ontario, in their approximation to each other. On the southern side, the basin is much wider, and watered by a far greater number of considerable rivers; of which the Raisin, Maumee, Sandusky, Huron, Black, Cuyaboga, and Grand, counting from west to east, are the most important. In beginning with the River Raisin, we shall preserve the continuity of description from the region west of Detroit River, till we complete the southern portions of the Erie Basin.

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\* Ohio Geological Report.



## SECTION I.

## BASIN OF THE RIVER RAISIN.

I. The mouth of this river is near the middle of the western end of Lake Erie, about fifteen miles south of Huron River, described in the last Chapter. The western portion of the district lying between these rivers, presents a rolling surface, with an elevation of a hundred feet or more above the lake, from which the streams descend with a rapid current; but when they reach the plain, but little raised above the lake, they form estuaries, into which its waters are driven by the winds. This belt, extending from the Huron to the Raisin, and including both, abounds in green marshes, relieved by low sand-dunes, which, at the present elevation of the lake, may be regarded as irremediable. The subjacent rock is Silurian limestone, which, after having emerged from under the coal basins of the south, is found here dipping to the north, to pass under the coal measures of the State of Michigan.

The sources of the River Raisin interlock with those of Grand River and the Kalamazoo, which empty into Lake Michigan. Its course is extremely serpentine, and its current at the same time swift, until it approaches the lake.

II. Monroe stands chiefly on the right or southern bank of this river, three miles, in a straight line, from the lake, but six miles, following the stream, as it meanders among the low alluvial islands of its little delta; on which the waters of the lake are driven, by every east wind, and every 'ground swell.' The approach to the mouth of this river by the lake, is over exceedingly shoal water, and the road from the dock passes, for a mile, through a flat, covered with aquatic grasses. It then traverses low sand ridges, to Monroe, which stands on a dry and level sand-dune. The river here has rapids, that begin above and continue to a point just below the town; the water descending over Silurian limestone rocks. The foot of these rapids is the head of the broad estuary of the river. It is doubtless well for Monroe, that this estuary and its marshy borders lie to the east or leeward; but the almost daily effusions of the lake are regarded by the physicians of the town, Doctors Landon, Conant, and Southworth, as limiting its insalubrity. Thus, they affirm that the people of Monroe, and those living between it and the lake, are but little affected with autumnal fever, compared with the inhabitants immediately above the falls, and westward of them, in the interior; where the tributaries of the Raisin are generally sluggish, and marshes more or less abound. In that region, as those gentlemen stated from personal observation, there is a great deal of autumnal fever, including many malignant cases, known among the people as 'chill-fevers.' Both Doctor Landon and Doctor Conant assured me, that they had repeatedly seen the breaking up of new soils in that quarter occasion fever.

Monroe stands near the site of an old Canadian-French village, settled as early as the year 1776, and known first as the 'River Raisin settlement,' and then as 'French Town'—the spot where the sad and memorable 'massacre of the River Raisin' took place. Doctor Conant, who came to it in the

year 1820, found it as healthy then as at the time of my visit, in 1842; but the surrounding country was more infested, at that time, with autumnal fever, than in latter years.

It has been said, that people who live near the falls and rapids of our rivers are peculiarly liable to autumnal fever; but this is certainly not the case at Monroe.

III. The lake shore, south of the River Raisin, for the distance of twenty miles, resembles that already described, consisting everywhere of broad watery savannas. The road to the south runs at the distance of three or four miles from the lake, through a forest growing on a post-tertiary clay plain, with occasional flat ridges of blown sand.

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## SECTION II.

### BASIN OF THE MAUMEE RIVER AND BAY.

I. THE RIVER. — The Maumee River, formerly called the Miami of the Lake, is one of the largest tributaries of Lake Erie; which it enters by Maumee Bay, about twenty miles south of the river Raisin, in Lat.  $41^{\circ} 40'$  N. The Maumee is formed by two rivers: — the St. Joseph, which has its origin in the State of Michigan, where it interlocks with the head-waters of the St. Joseph of Lake Michigan, and whence it runs nearly south-west, until it joins the St. Mary, the sources of which interlock with those of the Great Miami and Wabash — tributaries of the Ohio River. This spot, in Lat. about  $40^{\circ} 20'$  N., is the most southern extension of the St. Lawrence or Eastern Basin. Uniting in the State of Indiana, these rivers make the Maumee, which descends to Lake Erie in a direction nearly north-east. On its way, the Auglaize, equal in size to either of its elementary branches, joins it on the right or south-east side. The Wabash and Erie canal ascends the valley of the Maumee. At old Fort Defiance, at the mouth of the Auglaize River, it gives off a branch to Cincinnati, while another continues, in the same direction, to the Wabash River, in the State of Indiana.

The surface of the Maumee Basin is not hilly; but, as we advance into the interior from the lake, it gradually rises, until it attains the average altitude of eight hundred and fifty feet above the level of the sea. The post-tertiary clay deposit, so often mentioned, buries up the Silurian limestone, which constitutes the subjacent rock; over the out-cropping edges of which the river descends, by a series of rapids, eighteen or twenty miles long, which terminate at the head of the estuary. The banks of this river are in general well-developed; its inundated bottoms of limited extent. Compact and lofty forests, for some distance from it, spread out on both sides, but the upper portions of the basin abound in prairies, both wet and dry; the wide alluvial lands of many of its tributaries are subject to inundations; and on the flat summit-level between the St. Mary and Loraino Creek, a tributary of the Great Miami, there is an extensive artificial pond, designed to supply the canal with water.

II. **FORT WAYNE.**—Where the town of Fort Wayne now stands, there was formerly a military post of the same name, and an Indian agency. The site is a post-tertiary plain, at the junction and on the right or eastern side of the two rivers which form the Maumee. This plain rises above high-water mark; but is overspread with basin-like depressions, in which foul matters and rain-water accumulate, to be acted upon by the summer sun. At the depth of twenty or thirty-feet, hard well-water, of an excellent quality, is obtained. Between the town and the river there is a slip of low ground, which, although subject to inundation in spring, formerly became dry in summer, but is now kept wet by the leakage of the Wabash and Erie canal, which traverses it. On the opposite side of the St. Mary, and of the Maumee River, there are rich alluvial grounds, under cultivation. About two miles west of the town, a grassy marsh or wet prairie begins, and stretches off, indefinitely, to the south-west. Its width is from a few hundred yards to a mile and a half. It appears to be an obsolete bed of the St. Mary, which, in former times, might have flowed, in whole or in part, into the Wabash; a branch of which, called Little River, originating near Fort Wayne, now traverses that paludal tract. The St. Mary, as it comes from the south-west, flows through the eastern edge of this swamp. Beyond the low lands which have been mentioned, there is on every side a post-tertiary plain; which, at the distance of a few miles to the east of Fort Wayne, becomes a wooded swamp—the western edge of the ‘Black Swamp,’ to be hereafter described, but known here under the name of ‘Maumee Swamp.’ Doctor Charles E. Sturgis, in a communication from which this description has been made out, says—“I could name several instances where families settled in the unbroken woods, and clearing a very small space only, enjoyed uninterrupted autumnal health for three or four years; when other immigrants arrived, and extensive clearings were made, with the consequent breaking up of a great deal of new soil, and intermittents appeared among the whole.” As to Fort Wayne, from the time it was settled as a military post, down to the present day, it has been infested with intermittents and remittents; which, according to Doctor Sturgis, still occasionally present a malignant character. Of the prevalence of these fevers a judgment can be formed, from the fact, stated by Doctor Sturgis, that about four hundred ounces of sulphate of quinine are annually consumed by the people of Fort Wayne and the surrounding country. This, if we allow a drachm to each patient, would give three thousand two hundred; a large number, considering that the latitude of the town is  $40^{\circ}$  N., that the average elevation of the region is seven hundred and fifty-three feet above the sea,\* and that the population is sparse, compared with regions of Indiana and Ohio which have been settled for a longer period.

III. **MAUMEE BAY AND ESTUARY.**—Maumee Bay, in N. Lat.  $41^{\circ} 40'$ , is the south-western extremity or angle of Lake Erie, almost separated from it by two long, low, and tapering capes, which approach each other from the

\* Williams: Engineer's Reports, Indiana.



north-west and south-east. The former is called North Point—the latter Cedar Point. On the southern side of the bay there are grassy flats, so depressed that the waters of the lake, when driven by winds, flow over them. On the northern side there are similar tracts, a continuation of the green margin which extends round the head of the lake, from the mouth of Detroit River.

About two miles north of the Maumee estuary, there is another and narrower,—the mouth of OTTAWA RIVER, which enters an arm of the bay. This little river has its origin, thirty miles in the interior, on either side of the boundary between Ohio and Michigan; and, for the lower eight or ten miles, runs nearly parallel to the Maumee estuary, at the distance of three miles from it. The Ottawa trough is about a quarter of a mile broad; the waters of the lake, when driven by the winds, flow up it for several miles, and are overshadowed with pond-lilies, rushes, and other aquatic plants. Some of its narrow alluvions are alternately wet and dry, or covered and uncovered, according to the direction of the winds upon the lakes. As it flows through a post-tertiary argillaceous plain, its banks are well-developed, being from twenty to thirty feet high near the bay, and attaining a greater elevation as we advance up the stream.

The isthmus between the Ottawa and Maumee estuaries, consists of the same plain, heavily timbered, and more or less infested with patches of wet-weather swamp. A narrow slip, two or three miles long, of the southern part of this isthmus, is cut off by the obsolete bed or estuary of Swan Creek, which now enters the Maumee estuary three miles from the bay, but formerly traversed the old bed. The breadth of this ravine is from two to three hundred feet, and its wet bottom is overgrown with sub-aquatic plants; its mouth, which is near that of the Maumee, is so obstructed, that the waters of the lake do not flow into it except in high wind tides, or ground-swells. Swan Creek, above its present mouth, is a small mill-stream, flowing with a lazy and obstructed current through a winding trough, scooped out of the tertiary clay.

The narrow peninsula between the Maumee estuary and the old bed of Swan Creek, is the site of no less than three attempted towns. The first, beginning at the lake, is MANHATTAN, situated near the point of the peninsula; the second, TOLEDO; and the third, PORT LAWRENCE, which is now municipally united with Toledo.

The Wabash and Erie Canal leaves the bay at Manhattan, and passes up the northern side of the peninsula, in the obsolete bed of Swan Creek; but a side-cut brings it to the Maumee, at the mouth of that creek, whence it ascends upon the gradually rising post-tertiary plain, to the head of the estuary.

Immediately above the mouth of Swan Creek, an extensive grassy beach projects into the estuary from the high northern bank. The water which covers it is shallow, but never, I believe, entirely drained off.

We are now prepared to ascend the estuary to its head. The water is of no great depth, and varies in that particular as the wind on the lake is

south-west or north-east; the former sinking and the latter raising it, through a scale from one to five feet. When the river is swollen, moreover, a rise takes place in the estuary, with a perceptible current into the lake. The bottom of the estuary is composed of Silurian limestone, a part of the same formation which is seen at the falls above. Its wooded bluff banks are high, and composed of tertiary clay and gravel. As we advance upward it gets narrower, but at its termination expands, so as to embrace several islands,—of which the largest are Hollister's and Ewing's,—all liable to inundation, under long continued north-east winds on the lake, or high floods of the Maumee River, when the estuary and bay are obstructed with ice. The banks on each side are about sixty feet high, and composed of the same material as above. Here, again, there are three new towns, of which two on the left or northern bank, called Port Miami, and Maumee City, have become municipally one, under the latter name. On the opposite or southern bank stands the third, called Perrysburg.

At the distance of a mile above Maumee City, the river, as it descends in rapids over the limestone rocks, presents on its northern side a considerable tract of cultivated bottom, in connection with which there is an ancient bed of the river, inclosing a portion of the post-tertiary plain, called *Presque Isle*, and augmenting the wet or semi-paludal surface to the windward of the city.

As it passes over the plain, in its progress to the south-west, the Wabash and Erie Canal sends portions of its waters into the Maumee estuary, by a series of locks, through both Maumee city and Port Miami.

Perrysburg, on the other side of the river, stands immediately below the demolished Fort Meigs, on a plain of the same elevation with that which supports Maumee City. To the eye, this plain appears level. It stretches off to the south-east, and beyond the limits of the town shows a wet or marshy surface, overshadowed with tall trees, compactly arranged. This is the western edge of the notorious 'Black Swamp,' to be hereafter described.

The Maumee Basin, down to a late period, was inhabited by Indians, and is, therefore, a newly settled region; yet the connections of its bay and estuary with the interior, are such as give them great prospective importance; while their topography, in itself, is of decided interest to the medical etiologicalist; and hence I have dwelt upon it with some fullness. It remains to say, that the various forms of intermittent and remittent fever are in accordance with the state of the surface. From Doctors Smith and Perkins, of Toledo, Doctors Conant, White, St. Clair, Matthews, Van Every, and Dwight, of Maumee City, Doctor Peak, of Perrysburg, and Professor Aekly, now of Cleveland, but formerly of Toledo, I learned that, from the commencement of settlement down to the time of my visit, in 1842, the whole locality had been infested with those fevers; cases of which sometimes assumed a malignant and fatal character. Once, during that period, they had made their annual invasion as a wide-spreading and mortal epidemic, which deserves a special notice.

IV. EPIDEMIC OF 1838 AND 1839. — The summer and autumn of 1838

were signalized by a drought, of longer duration and greater geographical extent, than had been experienced from the first settlement of the country. It extended from the River Raisin, or some point further north, round to the head of Huron River, on the south side of the lake, if not still farther east. The country, quite up to the sources of all the rivers lying between the Raisin and the Huron, suffered in nearly an equal degree under its withering influence. On the bay and estuary of the Maumee, according to Professor Aekly, no rain fell from the 3d day of July, until the 15th of October. Doctors Smith and Perkins reckoned its duration at four months. In the upper valley of Sandusky River, as Judge Cary informed me, the last rain was on the 17th of May, after which none occurred until October. At Tiffin, lower down the same river, the wells went dry before the middle of July. All the smaller streams, throughout the whole region, were exhausted, and their beds became dusty. The wild animals, of every kind found in that region, collected on the banks of the larger rivers, and even approached the towns. Deer and raccoons were numerous between Toledo and Maumee City; quails passed over the town-plot; and the frogs of the shallow and sedgey waters of the old bed of Swan Creek, now dried up, migrated in countless numbers, through the streets of Toledo, to the estuary of the Maumee. The wet prairies of the interior were dried, and the grass of the dry ones withered; the marshes and pools of the post-tertiary uplands, even those of the 'Black Swamp,' from the Maumee to the Sandusky river, were evaporated; their bottoms cracked open from shrinking; the leaves of many of the trees growing in them perished; and, in some instances, the trees themselves were killed. Under this great drying process it was, that the ordinary autumnal fever was raised into such an epidemic as had not been known before. But its sway was not equal over every part of the region in which the drought prevailed. All the accounts concur in representing, that the localities which were ordinarily the wettest, suffered most, *et vice versa*. The excavation of the canal was at that time going on, from the mouth of the Maumee estuary, at Manhattan, up to its head, at Maumee City. The laborers, four or five hundred in number, were chiefly Irish, who generally lodged in temporary shanties, while some occupied bowers formed out of the green limbs of trees. It does not appear, that a greater proportion of these operatives suffered, than of the resident population; but a far greater proportion of those attacked, died. Professor Aekly gave me a fact, which deserves to be recorded. One contractor kept a liquor store, and sold whisky to all whom he employed, which was drunk freely by themselves and their families. The mortality among them was very great. Another lodged his operatives on straw beds, in the upper rooms of a large frame house, made them retire early, kept them from the use of whisky, and nearly all escaped the disease.

The occurrence of rain about the middle of October, with a subsequent frost, put an immediate end to the epidemic; but it returned the following summer and autumn, with equal or greater violence; though affecting, comparatively, but a small number of persons. It is worthy of remark, how-



ever, that in the eastern part of the region in which the drought prevailed, the year 1838 was less sickly than the two following years. From that period down to the present time (1848), the Maumee Basin has not, I believe, been visited by a serious epidemic.

V. THE BLACK SWAMP.—Between the Maumee and Sandusky Rivers, south of the western extremity of Lake Erie, lies the great forest, which has received the ominous name of Black Swamp. The rock beneath the surface consist of the upper or gray Silurian limestone, exceedingly arenaceous, which here and there swells up into gentle undulations or tuberosities, so as to present itself at the surface; but, on the main, is buried up beneath a deposit of post-tertiary clay, with gravel and pebbles. By this deposit, the inequalities of the rocky surface are made to disappear, and, of course, it is of various depths, from a few inches to one hundred and fifty feet. The lower and thicker bed is blue clay; the upper, yellow, covered with a thick layer of black vegetable mold. To the eye the Black Swamp appears level, and in traversing it in a direction parallel to the lake shore, such is no doubt the case; but the whole region has a very slight inclination toward the lake; as appears from the accumulation of water on the south side of a State road, which passes through it from east to west, while on the north or lake side, no such accumulation takes place, to the same depth. The levelness of this tract, taken in connection with the argillaceous bottom, explains the paludal or swampy character of its surface. From this surface there arises a miscellaneous forest, of greater density and loftiness than is to be found elsewhere, perhaps, in the Interior Valley of North America.

Without passing through, I entered it a short distance on the western and eastern sides, and am prepared to concur in all that has been said of its gloomy solitudes.\* While the roots of these gigantic trees, standing side by side in the compactest intercolumniation, retard the escape of the melting snows and the copious rains of spring, their overshadowing foliage so completely shuts out the sun of summer and autumn, as greatly to limit evaporation. The depth of water varies in different parts, according to their relative elevation. Doctor Rawson, of Upper Sandusky, informed me that he had seen large tracts, in which the water was from two to three feet deep, while on others it was only a few inches. Two small rivers, Toussaint and Portage, either originate in or traverse the swamp. Their troughs are broad and shallow, and, from the sluggishness of their currents, their bottomlands, within the limits of the swamp, are liable to inundation. South of this forest, toward the summit-level between Lake Erie and the Ohio River, prairies abound; while to the north there are extensive grassy flats, skirting the lake between Maumee and Sandusky Bays.

The chief settlements in the swamp are along Portage River; where, as Doctor Peck informed me, autumnal fever prevails. The detached families which, here and there, have placed themselves in its midst, without subduing much of the forest, enjoy better health. The shade, in fact, is so dense,

that the sun can exert but little direct action on the surface. The destruction of the forest, and the first breaking up of the surface, will undoubtedly be attended with a great prevalence of autumnal fever.

### SECTION III.

#### THE SANDUSKY BASIN.

I. The area of this basin is of very moderate dimensions, yet it embraces several localities of interest. The river originates on the water-shed between the Ohio River and Lake Erie, in connection with the sources of the Scioto River, whence it descends to the north, and flows into the head of Sandusky Bay. The length of this bay is about twenty miles; its breadth four or five; its axis, lying nearly east north-east and west south-west, is in the same plain with that of Lake Erie, with which it is connected by a narrow strait, formed by a head-land from the Portage isthmus on the west, and another, called Cedar Point, on the east.

II. SANDUSKY CITY stands on the southern bank of this bay, near its junction with the lake, and is separated from Cedar Point by a narrow creek or inlet, which opens into the strait; while its apex receives the waters of Pipe Creek, a small stream, which, flowing from the south-west, passes within two miles of the city, on the south. Silurian limestone rocks here constitute the shore of the bay, which is elevated, at the water's edge, four or five feet above it, and continues to rise for a short distance back, when it forms a plain, which was once a prairie. To this succeeds a lower, wood-land flat, through which Pipe Creek meanders. The rocky plain gives to the inlet which receives the waters of Pipe Creek, a firm and elevated bank; but at the distance of a couple of miles to the south-east of the city, the banks are depressed, and a tract of low grassy lake-swamp commences, and crossing the base of Cedar Point, stretches off to the east, along the lake shore, for many miles, to the mouth of Huron River. At the edge of the city-plat, to the west, there puts into the bay a small stream, with narrow alluvial grounds, over which the daily fluctuations of the bay carry its waters. To the west and south-west of the city, there are heavily timbered oak flats, for three miles, which gradually rise into a series or group of broken limestone terraces. Such is the topography of Sandusky City, which, *a priori*, is as salubrious as that of any other town on the coasts of Lake Erie; and experience proves that it is, in fact, one of the healthiest. This conclusion is sustained by information received from Doctors Tilden, Cochran, Austin, Lane, Morton, and Townsend. Malignant cases are almost unknown, and a majority of the mild are contracted in the country.

III. TEMPORARY RESIDENCE FOR INVALIDS.—No canal reaches the lake at the City of Sandusky, but here is the northern terminus of the railroad from Cincinnati, so largely traveled in summer and early autumn, when the Ohio River above that city is too low for speedy navigation; at which seasons of the year what are called the lake-fevers prevail. Traveling invalids.

who, during those months, might desire to sojourn for a while on the shores of the lake, would be as safe at this point as at any other which could be selected; while several objects and facilities conspire to render it attractive to persons of taste and intelligence. *First*, a yawl-voyage across the harbor, to Cunningham's Island. *Second*, an excursion by water to the gypsum quarries on the north-western coast of the bay, where they may see nature in the very act of manufacturing sulphate of lime out of carbonate of lime containing sulphur, and carry away illustrative specimens, containing beautiful crystals of sulphate of strontian. *Third*, a more distant voyage, of thirty miles, up the bay and river, the scenery of which, although flat and tame, is full of interest. After passing the gypsum quarries, the deep water becomes much narrower, and the color appears, first, of a dirty yellowish green, and at last of a brownish hue. On each side of the channel there are extensive shallows, from which grasses, pond-lilies, and other aquatic plants rise into green savannas, animated with white cranes wading in the shallow water, and flocks of the purple grackle (*Gracula quiscula*) feeding on the seeds of grasses; as in the winter they are seen, subsisting on similar food in the salt marshes of the Gulf of Mexico at the Balizo. At length a point is reached, where the shallows stretch off to the north, and conflux with those of Portago River and Bay, which have been mentioned; then the channel divides, and one becomes the mouth of Muddy Creek, the other of Sandusky River; but no banks are yet developed, and the boat meanders through fields of aquatic herbago. Tertiary clay bluffs finally appear, and the traveler finds himself at last in the town of Lower Sandusky, which is properly the head of the estuary. Here are the site and remains of the gallantly defended Fort Stephenson; and from this place a trip may be made, on an excellent road, into the adjoining solitudes of the Black Swamp. *Fourth*. Returning to the city, they will find other subjects of interest. A visit, by land, to *Custatia*, a few miles south of the city, where they may quench their thirst in the waters of '*Cold Spring*,'—a pellucid fountain, copious enough to turn mill-machinery,—which boils up through a deep rent in the Silurian limestone. *Fifth*. A voyage of a few hours to Maumee Bay and estuary, already described, at the head of which, near Maumee City, they may wander over the battle-ground of Wayne, in 1794, the site of Fort Meigs, and other localities of deep military interest. *Sixth*. A voyage of somewhat greater length, to the River Raisin, and a view of its bloody battle-field. *Seventh*. An afternoon's voyage to Detroit, with which there are so many interesting historical associations.

IV. VEXIOE is a hamlet on the southern shore of Sandusky Bay, four miles from the city, at the spot where Cold-spring Creek discharges its waters into the bay. From the city to this point the bank is so high as not to be overflowed; but immediately above the hamlet, one of those broad shoals, so common around Lake Erie, begins and extends up the bay for several miles. The depth of overspreading waters varies according to the direction of the wind upon the lake, but the surface is never dry. It is destitute of



trees, but densely covered with aquatic grasses, and other herbaceous plants. At all times, the people of the hamlet, standing, as it does, to the leeward of this permanently overflowed ground, have been subject to intermittent fever, which has sometimes, especially in former years, assumed a malignant type.

Of the autumnal health of the people living round the bay above Venice, I could not obtain a reliable account; but was told that it is better than that of those who inhabit the banks of the rivers which flow into it; which was ascribed to the depth and daily agitation of the waters from the fluctuations of the lake.

V. LOWER SANDUSKY.—Like Monroe, on the River Raisin, and Maumee City and Perrysburg, on the Maumee River, this town stands at the head of what corresponds to tide-water of the ocean; that is, at the highest point of lake influence; like them, also, it lies at the foot of long rapids, for those of the Sandusky River terminate at this place. The town, built on the west or left bank, covers a narrow terrace near the river, and ascends upon a higher, which is, in fact, the eastern edge of the Black Swamp. On the opposite side, is the newer and smaller town of Croghansville. The river-bottoms above and below the town, are narrow; and the former especially seem, from the rapid descent of the river, but little subject to inundation. The surrounding upper plain has, from clearing and cultivation, lost its marshiness, and shows what the whole of the Black Swamp might be made, under the same treatment. Thus, Lower Sandusky presents but few conditions favoring the production of autumnal fever. Nevertheless, that fever is far more prevalent here than in Sandusky City. Doctor Anderson, who had resided longest here, had, from the time of his arrival, encountered that disease. In former years, his practice extended for many miles down the estuary, and up the river along the rapids; during which he observed that the people below enjoyed better autumnal health than those above. Doctor Rawson, who had also been many years in the same place, testified to the frequency of that form of fever; the other physicians, in a very brief residence, had met with it; and Doctor Williams, of Croghansville, bore testimony to the same fact. It is probable, that the margins of the Black Swamp, lying to the windward of the town, are one source, at least, of this disease, which in 1838 and 1839 was as prevalent and violent here as at Toledo.

VI. TIFFIN.—The road, on the west bank of the river, up to Tiffin, runs over the cultivated margin of the Black Swamp; the marshes and swales of which are either drained or dried by the hand of cultivation. The river abounds in rapids, formed by the out-crop of the Silurian limestone. The bank, for the whole distance, twenty miles, appears to be at the same elevation above the river, showing a gradual inclination of the plain to the north.

The town of Tiffin stands immediately above the junction of Rocky Creek with the Sandusky river. The latter bounds it from the south-west round to the north, where the two streams unite; when Rocky Creek constitutes the boundary from that point to the south-east. Just above its mouth there is a mill-dam, which creates a pond; and below, there is a dam across the San-

dusky River, which gives a pond to the north-west and west. Doctor Dresbach has observed, that much of the autumnal fever of Tiffin was in the neighborhood of these ponds. Several times they have been drained in July, and the fever soon afterward broke out. The rapids of the Sandusky are still seen at this place. The bottom-lands are narrow. The post-tortinary plain, originally wet, is becoming dry under cultivation. From the statements of Doctor Dresbach, confirmed by Doctor McFarland, autumnal fever prevails more in this locality than at Upper Sandusky. Its greatest prevalence is in the Black Swamp, to the west and south-west of Tiffin. During the great drought of 1888, many of the swamps and swales were entirely evaporated; and the roots of previously vigorous plants became so dry as to burn like turf. Almost every family was taken down with fever.

VII. UPPER SANDUSKY.—This village, until lately the center of the tribe of Wyandot Indians, now residing at the mouth of Kansas River, represents the upper portion of the Sandusky Basin. The streams in this region are the Sandusky proper, with the Broken-Sword, to the east, and the Tyamoohtec, to the west. The two former originate in extensive swamps, and flow for some distance, westwardly, through a dense forest; the last, originating to the south-west, and flowing northerly, drains a gently-rolling tract of prairie and open wood-land. Near the banks of this branch of the Sandusky, is the spot at which Colonel Crawford was burnt by the Delaware Indians, in 1782.

The general character of the upper basin of Sandusky River, except its eastern part, where there are swamps, is favorably dry and salubrious. The prevalence of autumnal fever is unequal, but, on the whole, not great. Its latitude is a little below  $41^{\circ}$ —its elevation about nine hundred feet above the sea.

## SECTION IV.

### Basin of Huron River.

I. The mouth of this little river (which lies chiefly within Huron county, Ohio) is ten or twelve miles east of Sandusky City; its sources about thirty miles in the interior. In coming into this basin from the Sandusky River, we leave the Silurian limestone, for the superincumbent Devonian or black slate and sandstone, of the Appalachian coal formation. Many of the smaller streams have foul and tortuous beds. The estuary of the river extends to Milan, seven miles from the lake. Between the two there are flats and swamps, which likewise stretch westwardly along the lake, to Sandusky City.

II. A town, called Huron, has grown up at the entrance of the river into the lake, notwithstanding the locality seems, at all times, to have been unhealthy. A Canadian-French trader, who established himself there as early as 1702, told Judge Lane, of Sandusky City, that it was at first healthy, but with the progress of immigration, fevers appeared. From Mr.

Bolt, of Norwalk, twelve miles in the interior, I received the following facts. He was one of a family of eleven persons, who, in the month of August, 1822, landed where the town of Huron now stands. One of the party and himself remained on the spot for an hour only; but the other nine lodged there through the night, and then proceeded into the country. Within a fortnight the whole nine were taken down with fever, but he and his companion escaped. Some time afterward, not in the same year, he went, in autumn, from the healthy part of the country, where they resided, to the estuary of the river, and spent three days and nights upon its banks, about three miles from the lake; at the end of which time he was seized with intermittent fever. Twenty years after that time, as I was assured by Doctor Baker, of Norwalk, this locality was still infested with the same fever, to a much greater degree of malignity than the country around, or even the town of Milan, at the head of the estuary.

III. NORWALK. — This beautiful town stands five miles south of Milan, at a higher level, on one of the sand-dunes or terraces which lie parallel to Lake Erie. The covering of sand is but a few feet in depth, and rests upon the wide-spread post-tertiary clay deposit, so often mentioned. This deposit makes the bottoms of the wells in Norwalk; which are, therefore, only five or six feet deep. The fine sand of this terrace, when dry, is constantly raised into the atmosphere by the wind, and carried through every opening, into all the houses of the town. A reference to this condition will hereafter be made, in connection with other forms of disease than the one which now receives attention.

This locality might be expected to escape autumnal fever; but according to Doctors Baker, Kitteridge, and Tift, it does not. Doubtless, the immediate cause of the fever is not developed on the sand ridge, but at the distance of two miles to the west, where the ridge terminates, and a foul tributary of Huron River, with a dam and pond, exists.

Doctor Tilden, now of Sandusky City, was one of the earliest physicians of Norwalk, and from him I learned that, in the beginning of its settlement, intermittents, sometimes of a malignant and soporose character, prevailed. He also gave me the following fact.

IV. AN EPIDEMIC FEVER. — Early in the summer of 1810, there was an unusual drought, when, on the last Wednesday of June, a great rain fell on a tract five or six miles wide, extending from south-west to north-east, across Huron county, near Norwalk. In the space of a fortnight afterward, within those limits, eight horses died from fever, as their thirst and increased heat of skin clearly evinced. Sixty families inhabited the district, of which, soon after the fall of rain, fifty presented cases of autumnal fever, ranging from simple intermittents to remittents, which even simulated yellow fever. There had been much clearing of new lands, and the virgin soil had been extensively broken up.

V. MONROEVILLE is a smaller town than Norwalk, situated on the west bank of Huron River, without anything peculiar in its topography. Doctor Colo conducted me to a small stream in its vicinity, where there was a mill-



dam, which had created an exceedingly foul pond, having connected swales, bayous, and shallows, in which the trunks and limbs of trees were undergoing decay. Near the mill there was a hamlet, which, he assured me, suffered preëminently from autumnal fever, compared with the surrounding country.

To the west of Monroeville there are many broad prairies, which, under a rapid settlement of the country, were extensively plowed up, in a short time. The oxen were turned out in the evening upon the unplowed prairies, and were the next morning driven in, by *wading* after them through the tall grass, bending with dew. The persons who performed this duty were generally attacked with intermittent fever.

In reference to Huron county generally, Doctor Baker assured me, that tracts in which the clay deposit came to the surface, were more exempt from fever than the prairies, which had a deep covering of soil, or even the sand ridges.

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## SECTION V.

### BASIN OF BLACK RIVER.

I. THE RIVER. — This little basin, of the same class with the last, lies to its east. The sources of Black River, like those of the Huron, although within forty miles of the lake, interlock with the head-waters of the Muskingum, on a summit-level of nine hundred and seventy-eight feet above the sea. In its geological structure, the Black River Basin is composed of the Devonian slate and sandstone, supporting conglomerate, the whole of which dip to the south-east, beneath the Appalachian coal deposits. Much of the surface between Huron and Black Rivers, in the neighborhood of the lake, seems to be composed of disintegrated slate, forming an argillaceous bed, gently inclining toward the lake, and abounding in sand ridges, drifted by the winds or waves, when the surface of the lake was at a higher level than at present.

II. ELYRIA, the chief town of this basin, stands six miles from the lake, immediately above the junctions of the two principal branches of Black River. Below the town there are cascades in both; and then comes the estuary of the common trunk, with its flats and lake marshes. Each branch of Black River, has a dam above their junction, by which the town is subjected to the influence of a pond, both to the east and west. From Doctor Maister, and Doctor Howard (now a professor in the Starling Medical College), I learned, that the Black River Basin, generally, is subject to autumnal fevers; which the former gentleman had observed to be decidedly more frequent and dangerous along the estuary of the river, than about Elyria or elsewhere.

## SECTION VI.

## THE CUYAHOGA BASIN.

I. GENERAL DESCRIPTION. — This basin, which, in area, will bear a comparison with the Sandusky, lies east of the one just described. The junction of the Cuyahoga River with Lake Erie, is at the well-known city of Cleveland, in N. Lat.  $41^{\circ} 31'$ , and W. Long.  $81^{\circ} 40'$ . Although the river is more than sixty miles in length, its extreme sources are within ten miles of the lake, east of Cleveland, whence the river flows to the south-west for more than half its length, when it turns toward the lake, and unites with it, by flowing directly north. In the course of this great *detour*, it descends by falls and rapids two hundred and forty feet. The head-waters of this river are on table-land, the general elevation of which is about eleven hundred feet above the sea, or more than five hundred feet above Lake Erie. Its connections on this elevated level are, chiefly, with the Mahoning branch of Beaver River, which joins the Ohio thirty miles below Pittsburgh. At the junction of the Cuyahoga with the lake, the black slate is the lowest formation; in advancing from the shore, sandstone appears at a higher level; and in ascending upon the table-land of the upper part of the basin, we reach the conglomerate, on which rest coal beds that are worked. We have, in fact, here re-entered the great Appalachian coal basin, by its northern border. At first view this would not be perceived, for the aspect of this tract is different from that presented by the rim of that basin elsewhere. From Alabama to Pennsylvania, wherever we have approached it, the out-crop of conglomerate which supports the coal, has presented groups of high hills, connected by rocky spines, or rising, when distinct, into lofty cones, while deep and narrow gorges have taken the place of broad alluvial valleys, and swamps and ponds have been replaced by mountain torrents. Here, however, the peaks and summits have been removed nearly down to the level of the ravines; a sterile hill-country has thus been transformed into an elevated and fruitful plateau, incumbered with masses of its own rock, intermingled with huge granitic boulders, brought from some distant region of the north, perhaps, by the currents which effected the destruction of the hills. On this ancient geological change, depends its present medial topography. The general levelness of the basin gives to the streams a sluggish current, with wide alluvial grounds, subject to inundation; ponds are numerous, and extensive swamps not uncommon — the river itself rising in one of them.

Every part of this upper Cuyahoga Basin is annually more or less infested with autumnal fever, although elevated eleven hundred feet above the sea, and in the mean latitude of  $41^{\circ} 30' N.$ ; but the banks of the ponds and marshes are most infected. Thus, I was told by Mr. Coles, of Chardon, that when a dam was built across the Cuyahoga, at Burton, the people were, in the two next years, generally attacked by autumnal fever; and Doctor Hamilton, of the same town, informed me, that in the neighborhood of Burton, a

dam was demolished in summer or autumn, and nearly all the laborers engaged in the work sickened with fever. From Doctor Bennett, of Shalersville, I received the following facts. The Cuyahoga flows near the western side of that village, from north-east to south-west. To obtain water for the Mahoning Canal, a dam was thrown across the river, which gave rise to many cases of fever. Two years afterward, a higher dam was erected, lower down the river, which raised the water to the level of the first; involved the ruin of an old mill; produced stagnant water in the mouths of many small streams; inundated some forest land; and so intercepted the volume of water flowing in the river, that when it became reduced, in autumn, the whole was transmitted through the canal-feeder; leaving but a series of pools, in the partially dried-up river-bed below. During the first autumn after this signal change in the condition of the river, no injury to health was experienced; but in the next, nearly all the inhabitants, on both sides of the river, above and below the new dam, were attacked with autumnal fever. The number of cases was estimated at one hundred and fifty. They who lived near the river, had intermittents; those who resided further off and on higher ground, suffered more from remittents.

II. RAVENNA stands on a slight eminence, from which the rains flow off in all directions. At the distance of a mile, a tributary of the Cuyahoga winds round the town-site, from east south-east to west north-west. On this stream, two miles south-west of the town, a mill-dam was erected in the early period of settlement, and for five or six years, as Doctor Swift informed me, the people of the village and neighborhood were subject to intermittent fever. In 1810, the dam was demolished, and the bottom of the pond laid bare, when nearly all the inhabitants sickened with a malignant fever. In 1820 there was much less, and for the next fifteen years scarcely a case, except those contracted elsewhere. The Mahoning canal was then excavated, in the valley of the same stream, since which cases of fever have multiplied.

III. CUYAHOGA FALLS. — The town which, because of its locality, bears this name, is situate on the right or north-west bank of the river, where it enters the chasm through which it descends to its lower level. The inhabitants of the western part of the town, near the falls, as I was assured by Doctor Rice and Mr. Sill, are almost entirely exempt from autumnal fever; a fact worthy of being noted, as bearing on the opinion that the vicinity of a water-fall is insalubrious. Further up the river, there is a dam, causing a pond opposite and beyond the eastern part of the town, and three miles above, at Monroe, there is another. The gentlemen just named informed me, that nearly all the autumnal fever of their locality, occurs to the north of the lower pond; and Doctor Wright, of Talmadge, had, along that section of the river, no less than one hundred and fifty cases; while not a case occurred in his own village, which lies beyond the influence of the stream.

IV. HUNSON. — Doctor Town, of this place, who had practiced in it, and throughout the great bend of the Cuyahoga, for seventeen years, informed me, in a comprehensive manner, that autumnal fever had prevailed in all its



localities, but to the greatest extent by far along its water-courses, including the Cuyahoga. The least prevalence was in the town. Intermittents, especially, occurred on their banks; remittents in remoter and dryer places. In latter years, they are less frequent than formerly.

V. AKRON stands a few miles south of Cuyahoga Falls, on both sides, but chiefly the eastern, of the series of twelve or fourteen locks, by which the Ohio and Erie canal descends from a summit-level of three hundred and ninety-five feet above Lake Erie, and nine hundred and fifty-nine above the sea. The descent is down the steep valley of a small stream. The excavations for the locks, were made through a deep deposit of transported or tertiary materials. On the summit-level, the Mahoning canal traverses the eastern part of the town, to join that from the Ohio River. The water of the former is but slowly drawn off, and, therefore, stagnates. That of the other, from the constant ascent and descent of boats, is kept flowing. Near the junction of the canals there are two ponds and a marsh, and, at the distance of two miles, there is an extensive swamp; all lying to the south of the town. Near the locks, on the east, there is a marsh of twelve or fifteen acres, and, adjoining them, to the west, a series of little pools and swampy spots, created and kept up by the leakage of the locks. Thus, on the whole, marsh-exhalations, from the surface of the ground, and from the waters of the canal in their descent through the locks, together with aqueous vapor, must abound in this locality, as much as any other in the whole country. At a lower level, in a lower latitude, the fevers of autumn would, doubtless, be more violent than in this place; but, according to the evidence of Doctors Cole, Wallace, and Angel, intermittents and remittents prevail every summer and autumn, to a decided degree, both as to the number of cases, and their occasional violence. Compared with the towns of Ravenna and Cuyahoga Falls, the topographical conditions of which are, *prima facie*, more salubrious, Akron must be regarded as sickly.

VI. THE CANAL FROM AKRON TO CLEVELAND. — Doctor Cole was in Akron in the summer of 1825, when the excavation of the canal in the direction of Cleveland was commenced. The laborers suffered extremely from fever; at least eighty of them were his patients; but, as they worked in the valley of the Cuyahoga, they might have suffered, if they had not been engaged in exposing the fresh earth to the action of the atmosphere, sun, and rains. In 1826, many persons came from the surrounding country to work on the canal, and dispersed in June; but Doctor Cole afterward learned, that as large a proportion of those who went away as of those who remained behind, were seized with the fever. In 1827 and 1828, the same kind of fever returned. In the former year the water was let into the canal. In 1829 and 1830, but few cases occurred. In excavating the canal and the pits for two locks, within the limits of the city of Cleveland, in 1827, the laborers threw up a great deal of vegetable mold, and both they and the people of the town suffered severely from fevers; some cases of which might, by their symptoms, have been ranked with yellow fever. Doctor Long, of

Cleveland, romancers, that nearly the same results followed on the excavations all the way to Akron.

The result of my inquiries at this place, concerning the health of the canal boatmen, was, that although the boats are run throughout every night, and also, through the hottest part of the day, the men are less subject to autumnal fever, than the people of the country through which the canal passes.

VII. LOWER VALLEY OF THE CUYAHOGA. — The river below the falls and the Akron locks, flows through a kind of gorge in the black slate, and in some places presents rapids. Before reaching the lake, its valley widens, the stream becomes more tortuous, and its current slackens; in consequence of which, an immense quantity of drift-wood is lodged upon its margins. Many of its bottoms are liable to inundation, and the whole are overspread with rank herbaceous vegetation. As the river nears the lake, the sluggishness of the current increases, and opposing winds drive the waters of the lake more or less into its estuary, which is five or six miles long. The effect of such winds formerly was, to red the sands of the lake beach into the mouth of the river and choke it up; the obstruction being made greater, by the silt deposited from the stream, when its current was arrested. In times past, the river, thus turned aside, probably entered the lake at various points. On the settlement of Cleveland, as Doctor Long informed me, the mouth was seventy or eighty rods west of where it now is; and there remains to this day, a section of the river-bed, filled with water ten or fifteen feet deep, which exactly resembles one of the crescent lakes in the trough of the Mississippi.

On each side of this linear pond there are marshes, which extend up to the Cuyahoga. On the outer edge of the marsh, next the lake, there stands a tuberosity, several feet high, which, from its composition, is a remnant of the tertiary plain, which forms the bank of the lake, east and west of the mouth of the river. Immediately south of this marsh the river flows at the foot of a considerable bluff, and has a low and wet bottom on the opposite or eastern side; further up, the bottom is found on the western side, and then again on the eastern. These bottoms were once covered with forest. Their elevation is from three to four feet above ordinary high water. Formerly, when the river was obstructed at its mouth, these bottoms were occasionally inundated. At that time a pool was created in the estuary, which, in summer and autumn, when the river was low, became foul, and emitted an offensive smell, quite perceptible along its banks. The erection of two piers, projecting a considerable distance into the lake, by arresting the movement of sand, and compressing the river into narrow limits, has enabled it, when in flood, to wash away the bar, and thus preserve the purity of its estuary. Beyond the marshes and bottoms which have been designated, on both sides of the river, there are tertiary clay and sand plains, about eighty or ninety feet above the surface of the lake. West of the mouth, the broad marshy beach prevents the action of the waves upon the bank, but to the east the erosion of their foundations is so great, that extensive slides have taken place.

VIII. CLEVELAND. — The beautiful city of Cleveland, the settlement of

which was begun by immigrants from New England, in 1790, stands chiefly on a dry post-tertiary plain, immediately east of the junction of the river with the lake, fronting on both, and extending down to the river's edge. Going to the leeward of the river, with its bottom-lands, and of the old bed of the stream on the lake beach, with its marshes, it is exposed to whatever insalubrious exhalations may arise from them. At an early stage of its settlement, according to Doctor Long, these exhalations were very pernicious, as intermittent and remittent fevers, frequently assuming a malignant type, were common; but in latter years they are greatly mitigated. The same testimony as to their present mildness and rarity, has been given me by Professor Aekly and Doctor Mendenhall. In the course of his long experience at this place, Doctor Long observed, in some years, a great predominance of the intermittent type, in others of the remittent. The seasons which favored the former were wet and cool—those in which the latter prevailed were hot and dry. Malignant cases did not show themselves until about 1827, many years after the settlement of the place began.

IX. OHIO CITY is but an extension of Cleveland, upon the bluff of the western side of the river. In reference to autumnal health, it has the important advantage over the older and larger town, of being to the windward of all the low, wet, and foul grounds which have been mentioned; but, on the other hand, there is a considerable terrace-swamp, in Brooklyn township, at the distance of two or three miles to its south-west or windward. Doctor Mendenhall has given me two observations made on the site of Ohio City, which deserve to be recorded: *First*—laborers and watermen have been occasionally boarded and lodged on the edge of the swamp, near the west bank of the river, and they were exceedingly liable to intermittent fever. *Second*—in the southern part of the terrace on which the town stands, a deep excavation was made, in the bluff bank, to form a road of easy ascent, and the bluish clay thrown out, was used to fill up a street below, the effect of which was, to cause a local prevalence of autumnal fever.

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## SECTION VII.

### BASIN OF THE CHAGRIN.

CHAGRIN (more properly *Chagwin*) River enters the lake eighteen miles east of Cleveland; between which and it there are broad and elevated lake-terraces, generally free from swamps, well-cultivated, and partially defended from the winds and vapor of the lake, by a belt of woods. When I traveled on this terrace, in the month of September, 1842, the inhabitants appeared to be generally free from fever.

The sources of the little River Chagrin are on the northern edge of the conglomerate plateau, near those of the Cuyahoga, at an elevation of about twelve hundred feet above the ocean, and near six hundred and thirty above the lake. Like the Cuyahoga, this river runs, for a short distance, to the



south-west, to find a depression through which it may descend to the lake. In common with all the rivers of this region, it has its cataracts; from which it descends, by a rapid current, which is not checked until it arrives within a mile of Lake Erie. Its alluvial borders are narrow, and not subject to inundation; the upper part of its bed is composed of conglomerate, the middle, of Devonian sandstone, and the lowest, of black slate; finally, its cold and limpid upper waters abound in speckled trout (*Salmo fontinalis*), the popular sign that ague and fever need not be apprehended.\* On this point I can only say, that Doctor Card, of Painesville, who formerly resided in the village of Willoughby, two miles from the mouth of the Chagrin, informed me, that the country further up the river, was but little infested with autumnal fevers. It is otherwise, however, around the short estuary near the lake. The marshes, it is true, are of very limited extent; but the mouth of the river is generally choked with sand, and the free exit of its waters prevented. In the early stages of the settlement of the country, this limited locality was infested with fevers of a dangerous character. In the autumn of 1823 or 1824, nearly all the settlers were ill; and it was observed that of the citizens of the village of Willoughby, only two miles up the river, who went to their relief, nearly all sickened, while those who remained at home, continued in health. Willoughby itself is not, however, exempt from autumnal fevers; but, as Judge Allen and Doctor Card informed me, they are less prevalent than formerly.

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## SECTION VIII.

### Basin of Grand River.

I. The mouth of Grand River, is found twelve miles east of the one just described. Its sources interlock with those of the Cuyahoga and the Mahoning, at a mean altitude of eleven hundred feet above the sea. To descend from this elevated plateau, it takes a direction somewhat east of north, and after reaching the lake terraces, flows nearly west, through a channel which at length becomes remarkably tortuous, and with a sluggish current, which is arrested three miles before it reaches the open lake. When high, its water is turbid, at other stages brownish, but transparent.

II. On each side of the mouth of this river there is a marsh, the two covering about one hundred and fifty acres; but beyond the western, there are other swamps of great extent, separated from the lake by a narrow slip of higher land; beyond which, one of them, containing fifteen hundred acres, opens out to the lake. On account of the long piers, at the mouth of this river, the fluctuations of the lake are not much perceived in the estuary. The surrounding plain, fifty or sixty feet above the lake, is composed of transported or post-tertiary materials, resting on the black slate. Much of the water obtained by sinking wells into the plain, is of an inferior quality. The

village of FAIRPORT stands on a peninsular portion of the plain, immediately east of the mouth of the river; that of RICHMOND, a mile from the lake, on the western side, being built on two terraces. The prevalence and malignity of autumnal fever in these towns, have generally been quite as great as the etiologist would anticipate, from the unfavorable character of the neighboring topography. Information afforded me by Doctors Matthews, Card, Rosa, and Livingston, indicated that they were familiar with all the forms (up to the most malignant) of intermittent and remittent fevers, which infest similar localities in the south; but all concurred in representing the prevalence of those diseases as decidedly less than in the first years of the settlement of the country.

III. PAINESVILLE. — The site of this town, on the left or west bank of Grand River, is eight or nine miles from the lake, following the meanders of the stream, but only three miles, in a direct line. The slaty banks of the river are well-defined, and above its highest freshets. Much of the town-site is a deep and movable bed of sand. Like Norwalk, in fact, the town stands on one of the sand ridges which run parallel to the lake. In a ride with Doctor Rosa, to the south, in the direction of the highlands, I observed that we traversed several of these low ridges, between which, the more argillaceous surface was swaly. The swamps, however, which are near enough to Painesville to exert on it a mischievous influence, are those which have been described; all of which lie either to its north or north-west, and between them and the town there is a dense forest. According to the medical gentlemen whom I have quoted, the prevalence of autumnal fever in Painesville is small, compared with Fairport and Richmond.

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## SECTION IX.

### LAKE SHORE, FROM PAINESVILLE TO BUFFALO.

I. From Painesville, Ohio, to Erie, Pennsylvania, the distance is seventy-three miles. Between them there is no considerable river, nor any town of interest. The summit-level, between the Ohio river and the lake, through the whole distance, lies near the lake, and thus all the streams running into the latter are short. At Erie, its distance from the lake does not exceed ten miles. This part of the coast is, in fact, that to which the waters of the Mississippi make the nearest approach.

II. TOWN OF ERIE. — The site of Erie is a post-tertiary or diluvial terrace, forty or fifty feet above the level of the lake; from which it is defended by a long peninsula, the *Presq'-Isle* of the Canadian French, who once had a settlement at this place. Between this peninsula and the town is the excellent harbor, which is entered from the east, and opposite which entrance there is a margin of lake swamp lying north-east of the town. A small stream traverses the eastern part of the town-plot, to join the lake near the narrowest part of the passage into the harbor. The bed and banks of this stream

are composed of black slate, which has such a thin covering of transported materials, where the town is built, that many of the wells, not more than twenty feet in depth, afford water of an aluminous quality. The surface of the plain is more argillaceous than that of many other localities on the south side of the lake. To the south-west of the town, where the peninsula is connected with the main land, there was a swamp, which has been partially drained. The peninsula, generally, is but a bank of sand, bearing trees, and having here and there a small swamp or pond. South of the town, at the distance of two miles, there is a second and higher terrace, running parallel to the lake shore; in front of which there lies a hemlock swamp, fed by springs and rains; the larger part of which is to the summer-windward of the town. The Beaver and Erie Canal, by traversing, has partially drained it. Beyond this there are other terraces, bearing timber, and having more or less of swamp.

It appears from this description, that the medical topography of Erie, in reference to autumnal fever, is not of the most favorable kind. The late Doctor Johns, who settled there in 1822, found intermittent fever especially prevalent in the suburbs of the village to the south-west, near the stem of the peninsula, where marshes abounded; and also to the north-east in the vicinity of the same kind of surface. Remittent fever occurred in the central parts of the town; but for the first fifteen years he never saw a case of intermittent originate there. In 1830, the excavation of the Erie and Beaver Canal (*p.* 282) was begun; and continued till the close of 1841. From its commencement up to 1842, when I was there, intermittents had appeared among the people of the town, especially those living in its western parts, near the canal; and, on a second visit, in 1847, I learned from Doctor Wallace, Doctor Vosburg, and Mr. Sill, that intermittents continued to be prevalent throughout the whole, and that, by common consent, they were ascribed to the canal. Perhaps a partial draining and disturbance of the surface of the hemlock swamp, may have contributed to this insalubrity. The intermittents were generally of a mild character.

III. LAKE SHORE FROM ERIE TO BUFFALO. — From the town of Erie to the city of Buffalo, ninety miles, the lake coast runs nearly north-east, and for half the distance, that is, to Dunkirk, the high table-land on which the far-reaching sources of the Alleghany River, including Chautauque Lake (*Ch. X., Sect. I.*), have their origin, approach and terminate in rocky escarpments within eight to twelve miles of the lake shores. As that river belongs to the Mexican Basin, the Lake Basin here presents but a narrow belt; which lies about six hundred feet below the neighboring summit-level. All the streams which traverse this belt are but mountain rivulets, and their estuaries are correspondingly limited, as are the marshes of the lake shore. The terraces, so often referred to, rising above each other, as we advance from the lake, are found in this belt; but the amount of diluvium or transported materials is less; and for many long reaches, the road passes over the black Devonian slate, without any intervening deposit. East of Dunkirk the same condition of the shore continues, but the belt widens; the coast and the high-



lands diverge from each other; and the little river Cattaraugus (its cold upper waters abounding in speckled trout), by a length of fifty miles, and a descent of eight hundred feet, shows that the lofty plateau on which its headwaters mingle with the sources of the Alleghany and the Genesee Rivers, is comparatively distant. The highlands continue in sight, however, until we arrive within twelve or fifteen miles of Buffalo. Of the state of autumnal health, along the coast, from Erie to the Buffalo flats, which we encounter before reaching the city, I cannot speak from information, but, judging by its surface, would regard it as better than that west of the town of Erie.

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## SECTION X.

### CITY OF BUFFALO.

I. We have now reached the lower or eastern extremity of Lake Erie, where we find an extensive plain, which rises but a few feet above the surface of the lake. We have descended from the high terrace, on which we traveled round the southern side of the lake. The coast here runs nearly north and south. The city begins on its very margin, near the right bank of Niagara River. To the south and south-east, the plain, over an area of many square miles, is so low and level, as to have received the name of the *flats*. Their position, in relation to the city, may be seen in *Pl. XV*, but not their limits to the south-east, for they extend beyond the boundaries of the map.

These flats, once covered by the lake, were, at the beginning of settlement, overshadowed by a heavy growth of timber, much of which still remains. They embrace many ponds and swamps, and all parts are too wet and boggy for cultivation, until they are ditched. The water which drains from them is of a dark-brown color. Their western margin, for a considerable distance, is separated from the lake by a narrow belt of higher terrace, which gradually widens in going westwardly up the lake.

Buffalo Creek, the sources of which interlock, at a high elevation, with those of Cattaraugus Creek, and certain branches of the Genesee River, presents toward its sources, lively currents of pure cold water, abounding in speckled trout. The creek descends to the north-west, and on entering the flats, its velocity slackens, and it becomes discolored, by the oozeings of the marsh. Before it reaches the lake, it is reinforced by the waters of Little Buffalo Creek, entering it from the north-east. The approach of Buffalo Creek to the lake is at an acute angle, the course of the stream being nearly north. The junction takes place near the middle of the western line of the city, as may be seen upon the map. The deep and narrow estuary of this stream constitutes the harbor of Buffalo. For a couple of miles south of its junction, the neck of land between it and the lake, is a low sand-dune, over which the water, when impelled by westerly winds, sometimes breaks into the creek.

PL. XV.

Lower  
Black Rock

BUFFALO

Scale 1,000 to 1 inch

450 20 Swamp  
Sand

BLACK  
ROCK

CANADA

LAK  
E  
R  
I  
E





During a remarkable storm, on the night of the 18th of October, 1814, the waves were driven, in a deluge, into this part of the creek, and upon the flats, generally, to the depth of six, eight, and even ten feet. They also inundated the western and southern parts of the city, as may be seen by the dotted line on the plate.

The plain on which the city stands rises in a very gradual manner, and, beyond the line just mentioned, is above the highest known lake-floods; some parts of it finally reaching the estimated elevation of sixty to eighty feet. To the north-west of Main street, which nearly bisects the city from west to east, the surface abounds in low sand-dunes, or ridges; to the south-east of that street, it presents a more argillaceous character, and includes swales, superficial marshes, and even considerable ponds, which discharge their superfluous waters into Little Buffalo Creek.

The inhabitants are supplied with well-water, obtained at very unequal depths, and exceedingly various in quality; some of it being, as Doctor White informed me, offensive to the senses.

The Erie canal enters the front of the city from the north, and passes through it, near the lake, to terminate on the southern side; being connected with the estuary of Buffalo Creek by several lateral cuts. The vast commerce of Buffalo keeps the natural and artificial canals of its western or lake side, crowded with schooners, propellers, steamers, and boats, from which all manner of impurities must, of course, make their way into the stagnant water. The water, however, is not really stagnant, for the westerly winds drive that of the lake up the creek, and through several slips into the canal; and the easterly draw it out, by repelling the lake from the shore; and thus, much of the filth is carried away.

The position of Buffalo is in N. Lat.  $42^{\circ} 50'$ , and W. Lon.  $70^{\circ} 23'$ . The elevation of most of its plat is about five hundred and eighty feet above the sea. Its settlement commenced in 1801, when the surrounding country was a wilderness, and what is now the south-western part of the city was a morass. Its growth was slow; and being burnt, during the war with England, it recommenced the year 1814, with only four houses. Thirty years afterward, its population amounted to thirty thousand, and at this time (1848), may be estimated at forty thousand. Thus it is a new city, built on a spot which, until recently, was covered with forest.

The extensive paludal and boggy tract which lies immediately south of Buffalo, together with the impure waters of the canals and the estuary of the creek, are hydrographical conditions eminently favorable to the production of autumnal fever. Let us see in what degree they are really pernicious. Doctor Trowbridge began the practice of medicine at Buffalo in the year 1810, and has continued on the spot ever since. Intermitting and remittent (some of which were malignant) prevailed from the beginning. In some seasons the higher parts of the village were most infected; but generally, these fevers occurred chiefly in the vicinity of the two Buffalo Creeks. With the progress of rural and civic improvement, they have regularly diminished; until, at the present time, remittent fever is rare, and intermit-

tent almost unknown, except in the suburbs of the city. From Professors White, Flint, and Hamilton, I learned, also, that but little autumnal fever is encountered at the present time; and that, chiefly on or near the flats.

The following fact, observed by Doctor Trowbridge, deserves to be recorded. In the neighborhood of Buffalo, for three (but not successive) autumns, a local epidemic fever occurred among about twenty families, who drank and otherwise used water from the same spring. It burst out beneath a ledge of limestone, about twenty-five feet below the summit, beyond which, at the distance of a mile, there was a piece of wood-land with a pond, which Doctor Trowbridge supposed to be the source of the spring; for, after rains, its water became turbid. The autumns in which the fever prevailed, were unusually dry. In its symptoms and violence, the disease might have passed for yellow fever. Nine or ten persons died. The surrounding neighborhood remained healthy. The spring was at length abandoned, and the fever did not return. This *seems* to show that the material cause of autumnal fever may be absorbed by water, and then produce its characteristic effects.

In comparing the prevalence and mortality of autumnal fever with the topographical conditions of this locality, we must, I think, admit the restraining influence of climate; for, only a few degrees further south, such a state of surface would inevitably give rise to much more serious visitations of fever, than have generally been experienced at Buffalo.

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## SECTION XI.

### NORTHERN SIDE OF THE ERIE BASIN.

I. Having surveyed the southern slope of this basin, from the influx of Detroit River, to the efflux of Niagara River, at Buffalo, it remains to make an examination of the northern slope. To borrow from anatomy a fanciful illustration, we have traveled round the greater curvature of the expansion of a long natural canal, from the cardiac to the pyloric orifice, and must now survey the lesser curvature.

When treating in the last chapter of the river Thames, we saw that, originating far to the east of Lake St. Clair, it seeks that reservoir by a course nearly parallel to the northern shore of Lake Erie, from which the head-springs of many of its lateral tributaries are but a few miles distant. From the mouth of Detroit River, then, to a point nearly two-thirds of the way to the Niagara outlet, the northern lake-slope is so narrow, that the medical topographer is, in a manner, limited to the coast. Concerning this narrow lacustrine belt, which is more than one hundred and fifty miles in length, I can say but little. It appears to be, like the opposite or southern coast, a flat or terrace-like tract, overspread with a post-tertiary or diluvial deposit, here and there cut through by creeks and rivulets, as they descend to the lake. The lacustrine banks are generally bold, and, from the lashing of the waves against their base, often fall or slide into the water; which keeps the

shore soft and muddy. The northern are obviously more exposed to this kind of action than the southern banks, on account of the greater prevalence of southerly than northerly winds. Of the condition of the short estuaries on the side we are examining, I am uninformèd; but they may be presumed to resemble those of the smaller streams of the southern shore, in their stagnant waters and swampy borders. Away from the lake, there are occasional cedar swamps. Along this portion of the coast there is no considerable town, and the country is but sparsely inhabited.\*

This belt at length widens, partly from the upper part of the river Thames being further from the lake, and in part from a deep indentation at Long Point or Fore-land; formerly a peninsula, but latterly, from the action of the waves, converted into an island. Of this part of the belt, I know but little. Its medical topography may be said, in general terms, to be like that of the narrower belt, further west. Soon after passing Long Point to the east, we arrive at—

II. THE BASIN OF GRAND RIVER.—This is the only stream, on the north side of Lake Erie, which deserves to be called a river. The area of its basin may be compared with that of the Cuyahoga, on the opposite side of the lake. Pressing hard on the head or western end of Lake Ontario, Grand River enters Lake Erie, not far from its eastern extremity. Most of the land on this river is rolling. The soil, generally rich enough to support a miscellaneous forest, is also poor enough, in some places, to be covered with pine. The middle and upper parts of Grand River Basin are the best settled portions of Canada West; and may, from their latitude—between 43° and 44°—as well as from their rolling surface and the flourishing state of agriculture, be presumed to suffer but little from autumnal fever. Further down, the basin is inhabited chiefly by Indians of the Iroquois or Six Nations, who removed thither from the State of New York, after the revolutionary war. Lower still, and not more than five miles from the lake, stands—

III. THE VILLAGE OF DUNNVILLE.—According to Doctor Stratton,† the country around this village is heavily wooded, flat, and marshy. The river, fifty yards in width, has its banks so depressed, that in many places they are not a foot above its high-water surface. A dam has been thrown across it, to make a feeder for the Welland Canal, between Lakes Erie and Ontario; which has caused much overflow both above and below it, by preventing the descent of the water, in freshets, and arresting the ascent of that from the lake, when impelled into the estuary of the river by the wind. "The residents in the neighborhood," according to the gentleman just named, "are very subject to marsh fever, every family having several ill in the course of the season."

With this locality we finish the medical topography of the Basin of Lake Erie, and complete that of the group or series of upper and interior lakes;

\* Tulloch's Statistical Reports of British Army—Smith's Canad. Gazetteer.

† Edinburgh Journal, No. 147.



but before proceeding to those which lie more than three hundred feet lower, and also much nearer the sea, it may be well to take a few general views,

## SECTION XII.

### REMARKS ON THE BASIN OF THE UPPER LAKES.

#### I. FLUCTUATIONS AND CHANGE OF LEVEL OF THE LAKE-SURFACE.

1. *Tides*. — It has been settled, by the observations of Governor Cass, at the head of Green Bay,\* and of Mr. Geo. C. Davies, at Cleveland,† that there are no lunar tides in the upper lakes. This conclusion is in accordance with popular opinion.

2. *Daily fluctuations*. — The surface of the lakes, however, is tranquil in the calmest weather only; and whenever or wherever their shores are visited, the water is seen to be in a state of fluctuation, proportionate to the velocity of the wind. As this is much greater, generally, through the day than at night, especially in the warmer seasons of the year, it follows that the heaping-up of the waters against the shore, will often be higher in one part of the day than another; which seems to have given rise to the mistake, once somewhat prevalent, that there were regular tides. When the wind blows steadily for a certain time in one direction, the surface-waters are impelled from the windward shore, and thrown upon the leeward; leaving the swamps and benches comparatively dry on one side, while they are submerged more deeply than common on the other. When the water recedes, the decomposable organic matter of the estuaries and lacustrine marshes must, of necessity, be in part floated away; and a greater absorption of deleterious gases may, likewise, be supposed to take place, than if the same water remained in them. A swamp thus acted on will, of course, prove less injurious to health, than one remote from the lake shore, where the water continues unchanged. Some inland marshes, however, are fed by copious springs, and send out streams, whereby their noxious influence may, perhaps, be diminished.

3. *Ground-swells*. — When a strong and unrelaxing wind, not directed to or from the outlet of a lake, has, by blowing several days and nights, driven the water from one side to the other, as from the western to the eastern coast of Michigan, or from the southern to the northern coast of Erie, the surface of the lake becomes an inclined plain, and when the wind ceases, it will return to its horizontal state. This obbing is generally so gentle as not to be perceived; but occasionally the reflux is in the form of a long and high wave, which in its approach to the shore, has been compared, in appearance, to the fall of water over a mill-dam, when seen from below, and is called a Ground-swell, or Long-swell, by the people who live on the

\* Historical Scientific Sketches of Michigan, p. 194.

† Ohio Geological Reports.

const. Two or three of these undulations sometimes follow each other in quick succession. Mr. Butler, who keeps the lighthouse in Fairport, at the mouth of Grand River, in Ohio, informed me that he had seen this swell eight or ten times. In the autumn of 1820, three rapidly succeeded each other, and deluged the lower part of the village, five or six feet deep. There was no wind, and the surface of the lake was smooth, immediately before. At Lockwood, eight miles further down the lake, one of these waves caused an inundation eleven feet deep. They sometimes happen in the winter, when the ice near the shore will be raised up, and fractured, the water being driven through the fissures. The geologists of the State of Michigan have observed these swells in the bays of Lake Superior.

1. *Annual rise and fall of the Lakes.* — The lakes may be regarded as constituting a river, with expansions. Superior, Huron, St. Clair, and Erie, with the intervening straits, represent the main trunk — Michigan, and Green Bay, are tributaries. Below a horizontal plane, touching the bottoms of the straits, the water, of course, is not changed, except so far as it may percolate into the earth, and its place be supplied by rains. It is, then, the surface-water only that flows and constitutes the river. It follows, that if the lake-beds do not leak, the water which flows through the straits must be that which falls within their basins, in the form of rain or snow, minus the quantity raised by evaporation, and lost through absorption into the earth. Evaporation, of course, goes on from both the land and water, but its laws are not the same on the two kinds of surface. From the land-surface it takes place, but to a very limited degree, in winter, when the ground is frozen, and in autumn when it is dry; though in summer, when the surface is wet, from the spring rains, it must be active, as the sun's rays, by impinging on solid matters, develop a great deal of heat. Hence, terrestrial evaporation has two *minima* and two *maxima* in every year. The former are the months of August and September, the period of drought, and the months of December, January, February, and March, the period of frost; the evaporation being then reduced to its lowest degree. The *maxima*, or periods of greatest evaporation, are October, after the rains of autumn have fallen on the earth, warmed through the preceding summer, and May, June, and July, when the solstitial sun acts upon a surface watered by the copious rains of spring.

The extremes of variation in the rise of vapor from the lake-surface are much less, and do not correspond, in time, with those of the land. Thus, there is no lack of water throughout the year, except over the margins which become protected by ice in winter; and the difference between the summer and winter temperature of the water, beyond these icy belts, is not so great as on land. Hence, there is one *maximum* of evaporation in July, August, and September, and one *minimum* in January, February, and March; both depending on temperature.

The water which falls upon, or flows into, the lakes, has no progressive or river-current, and merely serves to swell their volume, and raise them to a higher level; but, from their great extent, this cannot take place suddenly.

Lying far in the north much of the rain which falls on the earth in autumn is converted into ice, and kept from reaching the lake-beds until spring; and all the snow which falls on the ground, from the first of December to the first of April, a period of four months, remains undissolved. The supplies being thus withheld, and evaporation still remaining active, from the long-retained heat of the lake-water, the lacustrine surface sinks to a *minimum*, which, by the month of February, is such that the ice formed near the shore in December, is found to subside, from following the water on which it rests, as the surface lowers. April and May bring their copious rains; the sun dissolves the accumulated ice and snow of the higher latitudes, and the swollen rivers pour their torrents into the lakes, which now begin to rise; and by June or July, a *maximum* is reached. This range of elevation, depending, as it does, on atmospheric causes, is, of course, not uniform, but varies from one to two and a half feet.\*

It is worthy of remark, that the great lacustrine river, having its extreme sources in the same region with the Mississippi, has its annual rise at the same season of the year; showing their dependence on a common cause. The effects of their redundancy of water, are, however, very different; for, while the floods of the Mississippi overflow its banks, and submerge large districts of alluvial bottom, making fresh deposits of organic matter upon them, the lake-floods are limited to narrow and interrupted tracts of beach, and to the low lands about the mouths of rivers; and when the freshets of both subside, those of the Mississippi leave extensive foul surfaces, to be acted on by the sun; while those of the lakes leave only margins, of inconsiderable extent; which, moreover, are exposed in a very gradual manner. Still further, the Mississippi falls to its *minimum*, with a consequent exposure of the greatest extent of drying surface, in the months of August, September, and October, while the power of the sun is still great in the south; but the *minimum* of lake depression is not reached until February.

5. *Prolonged lake rises.*—Colonel Henry Whiting,† from various traditional and unwritten accounts, and also from observation, has concluded, that the lakes rise gradually, and reach a maximum in seven years, from which they decline; and, at the end of a second septennial period, are found at their lowest level; whence they rise again, to their former elevation, by the close of the third septennial epoch. Thus, in 1800, there was high water; but nothing is known of 1807 or 1808. The years 1814 and 1815, presented high water, 1820 low, and 1828 high. It appears, however, that in 1829, after falling two feet, the water began to rise, and, in 1830, had attained the elevation of 1828; by 1836 it had advanced twenty inches higher; in 1837, it rose seven inches more, and in 1838, twelve inches of greater elevation were attained; immediately after which it began to fall. By these data a gradual rise through a period of seven years, seems to be obscurely indicated; but not a subsidence through the same term. From

\* Michigan and Ohio Geological Reports.

† Historical and Scientific Sketches of Michigan: 1834.



the best data extant, taking the depression of 1820 as one extreme, and the elevation of 1838 as the other, the range is six feet.\* The researches of Mr. Whittlesoy† have brought out nearly the same result. The highest known rise was that of 1838, which, along the St. Clair and Detroit Rivers, destroyed old orchards, and killed forest trees, the annual concentric circles of which exceeded one hundred in number.‡ Of course, an equal rise had not occurred in a century before. The prolonged periodical rises and falls, can only be ascribed to long periods of wet and dry weather, in alternation; and if an accurate account of the quantity of rain and snow, falling annually in various parts of the lake-basin, had been kept since 1800, the meteorological and hydrological conditions would, doubtless, appear at once, in the relation of cause and effect. All who reside on the banks of the Ohio are aware that, from atmospheric causes, the river has periods of two or three years, in which its mean elevation differs from that of other periods. The etiologist, in the atmospheric conditions which give rise to these fluctuations, will see modifying causes of the fevers of autumn.

II. TEMPERATURE OF THE LAKES, AND ITS INFLUENCES. — The mean annual heat of the surfaces of the different lakes must, of course, vary with the latitude, and is doubtless the same with that of the surface of the ground under corresponding parallels. The extremes of the water-temperature must, however, be much less than those of the surrounding land; for the fluctuations of the movable surface of the water, in summer, mix the warmer with the cooler waters; and, furthermore, the continued evaporation carries off caloric in a latent state, and tends to prevent a high surface-heat. In winter, on the other hand, when a film of ice is formed at the surface, the same fluctuations carry it into warmer water beneath, where it is immediately dissolved; a process that must continue until the whole stratum of agitation approaches the freezing point, and has no more caloric to impart. But the cold of our lake-climates is not great enough to reduce the upper stratum to the freezing point, where the water is deep, and hence the minimum of annual lake-temperature is less than that of the land — cannot, indeed, be down to 32° Fahrenheit. The depth to which the sun's rays can penetrate and warm the pure, transparent water, must be very great. They do not expend their caloric power on the surface, as they would, if the water were turbid from solid matters suspended in it. The observations already stated, in describing the middle lakes — Michigan and Huron — show that, in the same latitude, the summer temperature is inversely as the depth; and, of course, the winter heat must be directly as the depth. Great bodies of inland water, which for half the year are cooler and for the other half warmer than the soil, cannot fail to exercise an influence on the climate of the surrounding country, which the etiologist cannot overlook. That subject will receive attention in the meteorological portion of this work.

III. LAKE TERRACES AND THEIR EFFECTS. — Reference has been repeatedly

\* Michigan Geological Reports.

† Michigan Geological Reports.

‡ Geological Reports of Ohio.

made to these terraces, especially as they are found on the south side of Lake Erie. To what extent they exist around the lakes generally I cannot say, but they are nowhere so distinctly developed, I think, as in the vicinity of that lake. They are regarded by the geologists as conclusive evidence, that Erie, and, consequently, all the other lakes, in past times, existed at more than one level above the present surface. These terraces consist of long flat ridges of sand, which prevent the rain-water from flowing off; and they are thus one of the immediate causes of swales, swamps, and sometimes ponds; while the ridges, where the forest is cut down, fill the lower portions of the atmosphere with sand, whenever the wind blows. Superficial ditches, through the swamps and wet grounds, running parallel to the terraces, with deeper cuts at right angles to them, and, consequently, leading to the lake, would redeem all the terraces from their paludal condition, and greatly diminish the prevalence of autumnal fever.

IV. MARGINAL LAKE FORESTS. — As a general fact, the margins of all the lakes bear heavy forests, even when prairies are found but a few miles from them. These belts of wood-land are valuable to all who live on the southern coasts, as they resist and break the force of the northern winds which in winter sweep with such velocity over the watery surface. They are, in that respect, like the groves of the prairies of Illinois, and ought to be preserved. Where they surround a permanent lake-swamp, there is still another reason for their preservation.

V. I shall finish the medical topography and hydrography of the upper lakes, with a reference to the observations of Volney.\* In 1790, that distinguished French traveler made a visit into the basin of Lake Erie, concerning the fevers of which he says: — "In a journey of two hundred and fifty miles, from Cincinnati to Detroit, begun on the 8th of September, in a company of twenty-five persons, we did not encamp one night, without one, at least, of the party being seized with a periodical fever. At Greenville [on the upper waters of the Great Miami], the head-quarters of the army that had just conquered the country, three hundred persons, from among three hundred and seventy, were sick of fevers. On arriving at Detroit, only three of our party were in health, and on the ensuing day, our commander, Major Swan, and myself were both seized with a malignant fever. This fever annually visits the garrison at Miami Port [now Maumee City], where it has more than once assumed the form of yellow fever. \* \* \* These periodical fevers are not immediately fatal, but they sensibly enfeeble the constitution, and shorten life. If they seize their victim at the end of October, they are likely to continue all winter, and reduce him to a state of wretched languor and debility. Canada, and the adjacent cold countries, are little subject to them."

In the close of his article, after comparing various localities, he adds: "In the western country I would prefer to live, a hundred years hence, on

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\* View of the Soil and Climate of the United States: 1804.

the margin of LAKE ERIE, for then it will not as now be infested with fever." Half the time designated, has already elapsed, and the diminution in autumnal fever is such as to justify the expectation that his prophecy will be fulfilled.

## CHAPTER XIV.

### THE EASTERN OR ST. LAWRENCE BASIN, CONTINUED.

#### BASIN OF LAKE ONTARIO.

#### SECTION I.

##### HYDROGRAPHICAL OUTLINES.

I. THE BASIN. — The Lake Erie Basin terminates at Buffalo, where the Niagara River has its efflux; for all the water poured into that river by tributary streams, is carried into Lake Ontario. In tracing the outlines of the Ontario Basin, after passing a short distance to the east from Buffalo, we turn to the south, and ascend upon the Appalachian Mountains, to the interlocking sources of the Conesee and Alleghany Rivers, in latitude  $42^{\circ}$ ; then meander eastwardly, to the sources of the Susquehanna; then turn north-eastwardly, to the Adirondack Mountains in Northern New York; then north-westwardly into Canada West, until we approach the latitude of  $45^{\circ}$ ; and then curve round, by the south-west, to the place of departure at the Niagara outlet. Thus, the extreme latitudes of this basin, are from a little below  $42^{\circ}$  to near  $45^{\circ}$ ; its longitudes are from  $75^{\circ}$  to  $80^{\circ}$ . As the whole basin is habitable, and the best portions of the State of New York and of Canada West are included in it, no portion of the Eastern Basin is of deeper interest to the etiologist.

II. THE LAKE. — The form of Lake Ontario, is that of an irregularly compressed oval, with pointed extremities. Its length is about one hundred and eighty miles; its mean breadth, thirty-five; its average depth, five hundred feet.\* Its longest axis runs nearly east and west. The elevation

\* Michigan Geological Reports.



of its surface is two hundred and thirty-two feet above tide-water in the St. Lawrence, and three hundred and thirty-two below the level of Lake Erie. Its mean latitude is about  $43^{\circ} 30'$ , or nearly a degree and a half north of that Lake. The geological position of Ontario is in the older Silurian rocks; but the country around it abounds in terraces and long parallel ridges, of loose or drifted materials, which bury up much of the rocky strata, and afford abundant evidence that the surface of the lake was once much higher than at present. The outlet of the lake, at its eastern extremity, is the St. Lawrence; on the north side, near that extremity, is the estuary of the River Trent, the only large tributary of that side. On the south, and nearly opposite, is the mouth of Black River; further west, the Oswego, and then the Genesee; but the great supply of water, is that which must make the subject of the next section.

## SECTION II.

### BASIN OF THE NIAGARA RIVER.

I. The eastern extremity of Lake Erie and the western of Lake Ontario, overlap each other for the distance of about sixty miles. The isthmus between them has a width of thirty or forty miles. It consists of two belts, one of the same elevation with the banks of Lake Erie—another much narrower, and rising but little over the surface of Ontario. The descent from the upper to the lower is abrupt, and as we advance along the precipice from east to west, it approaches Lake Ontario, so as greatly to narrow the lower belt at the head of that lake. The eastern end of this isthmus is traversed by the Niagara River, through which all the superfluous waters of the Upper Lakes make their way into the Lower, by a course nearly north, and through a distance of thirty-five miles.

The tributaries of Niagara River are of inconsiderable size, and but two in number. That on the western side is—

*The Chippewa or Welland River*, which drains the upper terrace of the isthmus, and enters the Niagara River, half-way between the two lakes. The tract drained by this little river, consists chiefly of slightly rolling table-land, with a substratum of old or Silurian lime and sand stone.\* The surface, on the whole, appears to be dry. The Welland Canal, which begins by two heads, one in Lake Erie, and the other in Grand River, a few miles from the lake, traverses this district nearly at right angles to the Chippewa. I have not learned that those who reside near the banks, of the Chippewa or of the Canal, are subject to autumnal fever. On the eastern or opposite side of Niagara River, the chief tributary is—

*The Tonawanda*, which enters the Niagara a short distance above the Chippewa. A dam, near its mouth, constitutes it a part of the Erie Canal for fourteen miles, and, at the same time, interferes with the draining of the

\* Smith's Canadian Gazetteer.

extensive swamps, which lie within its basin, not far from the towns of Lockport and Batavia.\* Autummal fever abounds in the neighborhood of these swamps, which lie in the latitude of 43° N., and at an elevation of six hundred feet above the sea.

II. NIAGARA RIVER AND THE FALLS.—The banks of this river, where it emerges from Lake Erie, are low, its current slow, and its surface always of the same elevation; except when that of the lake is changed, by the action of the winds, or by the periodical rises and falls. Nine miles from Buffalo, the river divides into two channels, which, by their reunion, form Grand Island. At the distance of eighteen miles from the same city, the stream begins to descend a rocky inclined plain, and, by the depression of its beds, higher banks are developed. Here are the Rapids, in the course of which lies Goat Island, a wooded tract, composed of drift or diluvial materials, without swamps. The larger body of water passes on the western side of the island. Both the agitated and foaming torrents reach the precipice, immediately below the island, and plunge over it into the same abyss. The larger falls one hundred and fifty-eight feet—the smaller, one hundred and sixty-seven. From this pool, the depth of which is unknown, the water flows off in a comparatively quiet manner, with mural precipices on each side, which rise two hundred and fifty feet above its surface; but, at the distance of a mile, the Rapids are reproduced; and to them succeeds, from a bend in the ravine, the Whirlpool; whence the stream flows, in a dark and frightful gorge, till between Queenstown and Lewistown it emerges upon the lower belt; and traversing it with a rapid current for seven miles, reaches Lake Ontario, having descended, in the whole, three hundred and thirty-two feet.

All the geologists, who have visited the Niagara, have arrived at one conclusion concerning its cataract, and the chasm through which it flows. The rocks around and beneath the eastern end of Lake Erie (consisting of that limestone which, every where in the Interior Valley, underlies the black Devonian slate), crop out to the north, and constitute, at their termination, the heights of Queenstown and Lewistown, seven miles from the present margin of Lake Ontario. In ancient times these heights made the immediate bank of the lake, and then the Niagara River flowed through its whole length in a shallow trench, like that between Buffalo and Grand Island. Mr. Hall and Mr. Lyell have traced out the pebbly banks of this ancient river, from the Falls to the Heights of Queenstown,† and every visitor may do the same. At the geological epoch referred to, the strait between the two lakes, was like that between Lake Huron and Lake Erie at the present time. As the waters of Ontario subsided, the cataract was formed. The waters then began to fall from the heights upon the new lake-bench. By this fall, they broke up the lower strata, washed away their fragments, and the higher, losing their support, were broken off by the superincumbent weight, and thus the chasm was commenced. If the whole had been of equal density, a regular inclined plain would have been formed; but being of

\* New York Geological Reports.

† Travels in North America.

unequal hardness, the river necessarily descended by steps. One of these steps is the present cataract. As the rock over which the stream now falls, from its rising to the north, occupied, several miles below, a higher level, the descent must there have been through a greater space than at the present spot; and the longer the recession continues, the shorter will be the descent. Thus, the sublimity of the Falls is lessening with the lapse of time.

As the attractiveness of the spectacle they present is felt and acknowledged by the world, the medical historian is saved the fearful task of attempting to present it, as an inducement to summer traveling by invalids; and may limit himself to the humbler duty of answering the question, whether those who visit this locality in August and September, are in danger of contracting autumnal fever? The immense volumes of spray which are forever ascending, must necessarily render the local atmosphere humid; but, that condition does not seem to generate either intermittents or remittents. In the immediate neighborhood of the cataract there are no swamps; yet they are not very remote; for directly east, the country is level, and within three or four miles, there are swales and limited marshes. Five miles above, to the south-east, Cayuga Creek joins the Niagara. This creek drains a considerable tract of country, which is very flat and wet—known under the name of the Tonawanda Swamp. The shores of the river between the Falls, and this creek, present some marshes, a quarter of a mile in width. The lower end of Grand Island, four miles above the Falls, is flat and wet; and Buckhorn Island, lying near it, has a surface of the same character.

Autumnal fevers, both intermittent and remittent, prevail in the neighborhood of these islands; also near the mouth of Cayuga Creek, and along its banks, from the beginning of August to the end of September; but the village of NIAGARA FALLS is almost entirely exempt from both, though lying to the leeward of the paludal tracts.\* The Canada side is equally healthy.

In continuing the medical topography of the Ontario Basin, I propose to proceed eastwardly from the mouth of Niagara River.

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### SECTION III.

#### THE LAKE SHORE, FROM NIAGARA RIVER TO GENESEE RIVER.

I. FORT NIAGARA.—This military post is situated on a point of land, at the junction of Niagara River with the lake. Its site, in N. Lat.  $43^{\circ} 16'$ , is elevated several feet above the highest waves; and the country around, although remarkably level, is free from swamps or ponds. The returns for six years, give a ratio for intermittents of twenty-four per cent. per annum—for remittents, eleven per cent.† In the third and fourth quarters of the year 1838, a detachment of troops from Florida furnished nearly all the cases of fever; which, consequently, should not be charged upon this post. The

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\* Letter of Doctor G. Conger.

† Medical Stat. U. S. A.



tabular returns do not afford exact data for correcting the error from this source; but if it were done, the ratios of intermittent and remittent would be greatly reduced. Those outbreaks of intermittent and remittent fever, on coming into a cold climate, deserve to be recorded.

II. Around the whole southern coast of Lake Ontario, there is a bank or terrace, similar to those on the south side of Lake Erie, briefly described in the last chapter. Its development is most striking from the head of the lake, west of Niagara River, round toodus Bay, east of Genesee River;\* after which, its elevation and distinctness of outline diminish. In several places, instead of a single ridge, the platform widens and is crowned with several low ridges or spines. Its distance from the lake varies from three to eight miles; its elevation also varies in different places, but may be taken at an average of one hundred and ninety feet. In composition it consists of silt, gravel, sand, bowlders, shells, and fragments of wood.† Along the shores of the lake, between the ridge and the water, there are many ponds and marshes, formed by the obstacles which the shingle, or temporary raised beaches of the lake, present, to the discharge of the waters from the northern declivity of the ancient terrace. As now obstructions are forming by the action of the waves, while the same action, or the hand of art, is removing the older, it follows that the paludal character of this coast cannot be successfully obviated. To the south, or rear of the ridge, and between the low crests, where it divides into two or more, there are swales, morasses, and sometimes ponds, which render the terrace unhealthy in autumn. In very wet seasons, Dr. Elwood, of Rochester, has seen the inhabitants more unhealthy than those on the lake shore, although there were no swamps near them. The paludal tracts on or behind the terrace, may be abated by ditching, much easier than those adjacent to the lake; into many of which the waters are driven by the winds, by ground-swells, or by periodical rises; while others, as already stated, have their outlets obstructed with materials rolled against them by the waves.

III. At the mouth of the Genesee River there are tolerably extensive flats, on which the waters of the lake either stand permanently, or which they occasionally overflow. These flats were originally covered with trees, now partly cut down, and abound in aquatic plants. The estuary of the river passes through them. On the left-hand bank of this stream, stands the (comparatively) old and decaying village of CHAMLOTTE. In former times, Doctor Baucus and Doctor Elwood, of Rochester, saw in this village a great prevalence of autumnal fever, which often assumed a malignant character. When I visited it, in 1847, Doctor Jones, its only physician, was still grappling with the same disease; its type being generally intermittent, and seldom dangerous.

\* New York Geological Reports.

† Ibid

## SECTION IV.

## BASIN OF GENESEE RIVER.

I. A rapid survey of a part of the lake coast, in the last section, has brought us to the mouth of the Genesee River, which we are now to ascend to its sources in the mountains. The estuary of this river extends five miles from the lake, through a deep gorge of excavation. The navigation is arrested by falls, down which, by three successive leaps, the river descends two hundred and seventy five feet. This descent is over the terminal out-crop of rocks, which, like those of Niagara, emerge from the south. The lake ridge passes from two to three miles north of Rochester, at a level of about one hundred feet below it, and is intersected by the gorge.

II. ROCHESTER, the largest town of Western New York, except Buffalo, is of such recent settlement, that it was not regarded even as a village of the woods, until 1817. Its latitude is  $43^{\circ} 8' N.$ ; its distance from the mouth of the Genesee River, seven miles; its elevation above the lake, two hundred and seventy-five,—above the ocean, five hundred and six feet;—which is the average altitude of Cincinnati;—and being just four degrees of latitude apart, they are convenient stations for estimating the influence of latitude on climate, and on the diseases which, directly or indirectly, are produced by it.

The site of Rochester approaches nearly to loveliness, and consists of a moderately deep bed of loam, overspreading the same kind of Silurian limestone that is found at Niagara Falls. Originally the surface was swaley, but at this time there are no paludal or pondy tracts. The Genesee River passes through the town from south to north, and has a rocky bed and banks. To obtain water for the Erie Canal, which here crosses the river, and also for milling purposes, a dam was erected across the river, producing a pond for several miles above, which was said to generate a great deal of autumnal fever. Several years afterward, a second dam, which raised the water two feet higher than the first, was constructed, and produced such an increase of autumnal fever, along the banks of the river, that after five years it was torn down.\* A mile south of Rochester, there are high deposits of drift, which made part of a long range running parallel to the lake. They are not disposed in terraces but tuberosities, some of which are so elevated that the lake may be seen from their summits.

Doctor Backus and Doctor Elwood came to Rochester in the years 1816 and 1817, when it had not more than three or four hundred inhabitants, and the immediate vicinity of the village was a dense wood. At that time, and for many years afterward, intermittent and remittent fevers, frequently of a malignant character, were exceedingly prevalent. With the extraordinary growth of this beautiful city they have greatly diminished: nevertheless, they have not disappeared; for, as Doctor Ely informed me, sporadic cases of both occur every year, even in the depths of the city.

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\* Doctor Ely, of Rochester.

III. THE GENESSEE FLATS. — At the distance of twelve or fourteen miles from Rochester, up the river, the celebrated Genesee Flats commence, and extend to Dansville at the mouth of the Canaseraga Creek, a distance of fifty miles. The Genesee River descends into these flats on the western side, seventeen miles below where that creek enters them. The two streams unite, but even when thus augmented, the Genesee River bears no assignable proportion to the breadth of the flats through which it meanders with a sluggish current. They are, in fact, the bottom and bed of a drained lake, of the same class, in form and the direction of its axis, as the existing small lakes, which lie to the east, and discharge their waters into Oswego River. The width of these flats is from two to four miles. On each side, the ground rises by terraces or undulations, to a moderate height in the north, and a much greater height at the south, and is deeply overspread with diluvial or post-tertiary deposits, bearing or imbedding innumerable boulders. By cultivation, the surface of this upland has become dry, with here and there, a swamp or pond. As to the flats themselves, they were originally covered by a dense forest, with tracts of prairie,\* nourished by a soil abounding in organic matter; which, from the levelness of the surface, was badly drained, and on which the inundations of the river left ponds and marshes. The elevation of this lake-bed is six hundred feet above the ocean — its mean latitude, a little less than 43°. Its settlement began in the year 1788, but it was not until after the commencement of this century, that immigrants flocked to it, and the work of surface-transformation was undertaken in good earnest. Then it was that autumnal diseases began, and continued to prevail among the settlers so universally, that the expression, 'Genesee Fever,' became a familiar appellation. Doctor Backus and Doctor Elwood, who, as I have said, arrived at the infant village of Rochester in 1816 and 1817, were well-informed of the extraordinary prevalence of autumnal fever in the flats above them; and Doctor Bissell and Doctor Metcalf, who, three years afterward, settled in Genesee, thirty miles above Rochester, had personally witnessed the annual recurrence of the disease, commencing in the spring, under the ordinary form of vernal intermittents, and continuing until arrested by the frosts of autumn. According to these gentlemen, the tertian type prevailed over all others. Malignant intermittents do not seem to have been frequent, but the remittent form was often unmanageable and fatal. Doctor Hunt, who came in 1825 to Mount Morris, where the Genesee River enters the western side of the flats, informs me, that the people who lived on or near them, including those of the village, were great sufferers from intermittent fever, which he learned had prevailed from the commencement of settlement. It was seldom fatal, and most of the deaths were from the remittent type. Doctor Salisbury, of Avon, on the eastern bank, below Genesee, had settled there in 1830, when he collected traditional accounts of the same prevalence. Doctor Lauderdale, who had come to Genesee in 1840, had,

\* New York Medical Reports, Vol. II.



from every source, received the same impression. Such was the effect of disturbing this alluvial surface, so rich in organic matter.

With the progress of settlement and cultivation, although marshes remain and occasional floods occur, a signal amelioration in the state of autumnal health has taken place. All the gentlemen I have named testified to this as a fact; and although both intermittents and remittents continue to return annually, the number of cases, compared with the present population, is so small, that a residence in or around this beautiful and attractive locality, is no longer dreaded.

In 1837 and 1838, the Genesee Canal, from Rochester, was excavated through the flats, to its southern termination at Dansville. The work, as usual, was chiefly performed by unacclimated Irishmen, who, as Doctor Salisbury informed me, suffered much from fever, especially while carrying the excavation through a swamp, on the opposite side of the river from Avon.

IV. BASIN OF THE GENESÉE, ABOVE THE FLATS.—The whole of this region is composed of hills and valleys, with a gradual rise of the country from six hundred feet, the level of the flats, to more than fifteen hundred, where the sources of the river interlock with those of the Alleghany, Susquehanna and Cataraugus. The summit-level between Black Creek of the Genesee, and Oil Creek of the Alleghany—composed of an extensive mountain swamp—is fourteen hundred and eighty-six feet above the ocean, while other points are still higher; as, for example, Lime Lake, a small body of water, which lies on a portion of the summit-level, between the tributaries of the Genesee, Cataraugus and Alleghany, at an altitude of sixteen hundred and twenty-three feet above the sea.\* Geologically, the region we have now entered is composed of Devonian slate, surmounted with sandstone, and capped on its highest points with the conglomerate which emerges from beneath the coal basin of Pennsylvania. As the Genesee makes its way down this hilly declivity, it presents some striking cascades and deep ravines. In other places, it has bottom-lands of considerable width, which are also found along some of its tributaries. Most of the hills have long gentle slopes, and, in some places, are flatted into tracts of table-land. Swamps, chiefly overgrown with hemlock, are frequent, and not limited to the valleys. In the upper part of the basin, the head streams of the Genesee, Cataraugus, Alleghany and Susquehanna, constitute a sort of hydrographical labyrinth, from which the waters make their way into Lake Ontario, Lake Erie, the Gulf of Mexico, and the Chesapeake Bay.

In ascending this mountain slope, although we go directly south, we find that the fevers which prevail on the flats below, and down to the shores of Lake Ontario, get less and less. They prevail more along the Genesee River, and for a short distance up its tributaries, than elsewhere; but at length are almost unknown in every kind of locality, even the most paludal. At the village of Pike, on the banks of the transparent West-Koy, six or eight miles from the Genesee River, and at an elevation (by estimate) of

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\* New York Geological Reports.

twenty hundred feet above the sea, Doctor Vapron, who had resided there twenty-eight years, assured me they were unknown; adding, that the stream abounded in *trout*, a certain sign of exemption from that disease. Cases of remittent fever, however, now and then occur. Doctor Minard, of the same village, confirmed these statements; but informed me that both intermittents and remittents occur, to some extent, near the junction of the West-Koy with the Genesee, and, also, on the corresponding portion of a neighboring tributary, Cold Creek.

The summit-level on which the Genesee, in common with the Alleghany River, originates, lies between  $42^{\circ}$  and  $42^{\circ} 30'$  N. latitude, and has an elevation varying from thirteen hundred to sixteen hundred feet. It is about one degree farther south, and twelve hundred feet higher than the shores of Lake Ontario, between the mouths of the Niagara and the Genesee Rivers. Now, an autumnal fever, especially the intermittent variety, is the principal endemic of those shores, but almost unknown on this platform; and the difference must be ascribed to altitude, as swamps, streams, and organic matter abound in this region.

V. ALPINE SUMMER RESIDENCE FOR INVALIDS.—When describing the sources of the Alleghany River,\* including Chautauque Lake, we were brought, by a southern route, upon the water-shed which we have now ascended from the north. It may be regarded as the great salient terrace, or projecting table-land, of the Appalachian Mountains—that portion which advances farthest to the north-west, from the central axis of the chain—that which approaches nearest to the great lakes. Its tabular yet undulating or hilly surface, results from its resting on a broad out-crop of Devonian shale and sandstone, in which the former greatly predominates. Its rugged and rocky eminences depend on remnants of superincumbent conglomerate, the body of which lies further south, and at a lower level. These spots have a sterile soil, with the tree and shrub vegetation which belong to stony localities, at such an elevation. They make, however, but a limited portion of the whole district, and the extent of fertile land is such, that flourishing towns and villages, productive farms, good summer roads, and cheap and easy means of conveyance, are found in every part. Here, then, are all the requisites for a comfortable and curative *summer residence*. I will mention a few classes of patients, to whom it would be likely to prove beneficial. *First*. Those who are inclined to tubercular consumption, or in whom the disease, although fatally established, is not so far advanced, as to confine them to the house. To which may be added, children affected with scrofula in the external lymphatic ganglia, the skin, and the eyes. *Second*. Those who have had their livers and spleens deranged, in structure or function, or their constitutions otherwise shattered, by repeated attacks of autumnal fever, in low and hot situations. *Third*. Dyspeptics, from any and all causes; hypochondriacs, and those subject to chronic hyastria, or any other form of morbid sensibility.

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\* *Ante*, pp. 277, 278, 279.

Every practical physician is aware of the frequent failure of all kinds of medication in these cases, and of the great value of cool and fresh air, in summer, united with active exercise, simple diet, new scenery, and the disuse of medicines, or their use under these favorable circumstances; all of which may be here enjoyed.

From Mayville, at the west end of Chautauque Lake, to Bath and Elmira, on the Chemung River, a branch of the Susquehanna, the distance is more than one hundred miles; from Portago, on the Genesee, to Warren, on the Alleghany, more than fifty; and between these places there are many other interesting villages, which would afford ample opportunities for choice and change. In some of these towns there are respectable, in the remainder, plain but cleanly and comfortable, taverns; the general style of living is adapted, by its simplicity, to the constitutions of the infirm; and the milk of certain portions of the district, as around Chautauque Lake, from the qualities of the grass, is the best within the limits of our Valley. Churches of different protestant denominations are to be found in every village; which has likewise a nucleus of cultivated society; and one or more intelligent physicians, to be consulted in case of need.

The summer climate of this region may be inferred from a few facts. I passed through it in the last week of July and first week of August, and found fires, at night, acceptable. Frost occurs regularly in June and August, and not unfrequently in July. I saw many fields of Indian corn that had been frost-bitten on the night of the third of August. Peaches are scarcely cultivated. The wheat, and even hay harvest, does not take place until August. In passing north to Lake Ontario, I met the seythemen, who had completed the harvest in the country below, advancing south, and mounting on the higher level, to continue their labors.

It may be said that the Virginia Springs are more elevated, and, therefore, better fitted for summer sojourn. But their greater elevation of five hundred feet, would, in the reduction of temperature, only equal a degree of latitude, while this region is four degrees further north. Nor can Saratoga be compared in its summer climate with this mountain platform; for, although a degree further north, it lies twelve hundred feet nearer the level of the sea. The celebrated Springs of Virginia and New York are, moreover, places of amusement for the healthy, not rural retreats for the infirm; to some of whom, it is true, the *mineral waters* might prove beneficial; but all other circumstances would combine to counteract their salutary influence.

The enlightened physician, who conscientiously desires to redeem his patient, for three months of the year, from the deleterious agency of heat and malaria, or to countervail the debilitating effects of a protracted summer on others, in whose lungs the fatal work of tubercular excuvation is going on, will, I trust, not regard the business-like details which I have been giving, with disfavor; but patiently read on, until he qualifies himself for overcoming the scruples of such valetudinarians, as may fear or fancy that, in going to the mountain terrace for the summer, they would languish for want of scenes and objects of interest. These are quite as numerous, diversified, and



striking as in almost any other portion of the Interior Valley; and I will briefly enumerate the most important.

*First.* — This region comprehends the great Pine Forest of the Alleghany Mountains. White pine, yellow pine, and hemlock, are the prevailing forest trees: in the barren soils, mingled chiefly with oaks, chestnuts, chinquapins, and whortleberries; — in the fertile, standing side by side, in strange association, with the sugar-tree, elm, beech, walnut, and birch. From this district it is, that pine boards make their way to the lakes, the Chesapeake Bay, and even the Gulf of Mexico. Every water-fall has its saw-mill, every stream its raft, and the ax of the sturdy laborer enlivens the quietest solitudes. *Second.* — A residence in Mayville, at the west end, or Jamestown, at the east end of Chautauque Lake, would afford to the invalid many delightful drives on the serpentine banks of that beautiful sheet of water, elevated seven hundred and twenty-five feet above the level of Lake Erie; and a visit to LIME LAKE, in the adjoining county of Cataraugus, would show him a smaller basin, at the altitude of ten hundred and sixty feet above Lake Erie, or fifty feet above Itasca Lake, in which the Mississippi has its origin. *Third.* — In the same county, near Great Valley Creek, he may ascend a hill, and on its summit, about two thousand feet above the level of the sea, explore a tract of more than one hundred acres, which presents huge masses of conglomerate, so separated and arranged, as to justify the fanciful appellation which it has received, of Rock-City. *Fourth.* — A visit to Portage would afford him a view of the Upper Falls of Genesee River; which, in the course of two miles, by three successive pitches, and some intermediate rapids, sinks four hundred feet; each cascade displaying a peculiar beauty and grandeur; on which, however, the beholder can scarcely fix his attention, because of the emotions of awe and wonder, inspired at finding himself on perpendicular banks, which rise from three to four hundred feet above the surface of the river,\* as it winds its way through the gorgo. *Fifth.* — Many of the brooks which flow towards the north, abound in speckled trout, while the little lakes and rivers afford opportunities for successful angling, and many wild and rugged tracts invite to hunting. *Sixth.* — Such invalids as might, from taste or the hope of benefit, desire to visit a mineral spring, could, in a single day, or more, according to their position, descend to the Avon Springs in the Flats of the Genesee, twenty miles above Rochester, where they would find excellent accommodations, ample opportunities for bathing, and a copious supply of water, containing, according to Doctor Salisbury, carbonate and muriate of lime, and the sulphate of lime, soda and magnesia, with carbonic acid, nitrogen, and sulphureted hydrogen gases. These springs have been found peculiarly useful in disorders of the digestive organs, chronic rheumatism, and diseases of the skin. *Seventh.* — In a single day, or in two days, the valetudinarian might descend to Buffalo and the Falls of Niagara, whosce, if he chose, he could make a voyage to Mackinac or Quebec, and then return to his mountain retreat.

\* New York Geological Reports.

It remains to indicate to the invalid of the West and South, the routes by which this place may be reached. That by way of Pittsburgh, through the Valley of the Alleghany River, is wild and picturesque, but rugged, badly provided, and wearisome. From Rochester, the trip up the Genesee Valley is direct and pleasant. From Buffalo, the ascent to Chautauque Lake can be made in a single day. But of all the routes, that from Dunkirk to Mayville, at the western extremity of Chautauque Lake, is to be preferred. The invalid, once on Lake Erie, may be landed at the port just named, and in a single hour will find himself on the western promontory of the platform, at least eight hundred feet above the surface of the water.

## SECTION V.

### BASIN OF OSWEGO RIVER, WITH ITS LAKES.

I. This is the region of small lakes. It lies adjoining the Genesee Basin, and extends eastwardly to the sources of the Mohawk River, which flows into the Hudson. It rests, to the north, on Lake Ontario, extending even to its eastern boundary. To the south, it is subtended by the east and west branches of the Susquohanna—penetrating deeply between them. The Appalachian Mountains are here so depressed, that the water-shed between Seneca and Crooked Lakes, and the West Branch of the Susquohanna, where the Chemung Canal crosses it, is only eight hundred and ninety feet above the level of the sea. All the streams of this region, which take their rise in the mountain declivities, terminate in the lakes of the Oswego Basin, and are, therefore, small and short. The outlets of the lakes have their confluence in a common trunk,—the Oswego River; which reaches Lake Ontario, near its eastern extremity. The larger of these lakes, from west to east, are the Canandaigua, Crooked, Seneca, Cayuga, and Oneida. The smaller ones are equally numerous. The whole are long, narrow sheets of water, lying nearly parallel to each other, with their axes north and south. Their elevation above the sea varies from three hundred and eighty-seven to seven hundred and eighteen feet. A deduction of two hundred and thirty-one from these numbers, will give their altitude over Lake Ontario. In depth they vary:—Crooked Lake averages two hundred feet; the greatest depth of Seneca Lake, is five hundred and thirty feet; of Cayuga Lake, three hundred and ninety feet.\* These numbers explain why they were not drained, when the Genesee Flats were laid bare. Their beds, in fact, are excavations in the Devonian and Silurian rocks, which appear *in situ*, on the opposite sides of each. Their immediate banks rise from ten to sixty or eighty feet above their surfaces, and the country between them, attains, by terraces or gentle declivities, an elevation of several hundred feet in the south, but less in the north, where it assumes a more level aspect. At the

\* New York Geological Reports.

head of Cayuga lake there is an extensive swamp; but, in general, its margins are dry, till we approach its outlets, when we reach the most extensive paludal region which exists on the southern side of Lake Ontario. The outlet of Canandaigua Lake is into a stream called Mud Creek, which flows eastwardly. From the point of junction, the river takes the name of Olydo, and continues eastward as far as Montezuma, where it receives, through the Seneca outlet, the waters of Crooked, Seneca, and Cayuga Lakes, and then, continuing east, through Cayuga county into Onondaga county, unites with the outlets of Onondaga and Oneida Lakes, with which it forms the Oswego River.\* By this channel, the course of which is nearly north-west, all the superfluous waters of fifteen lakes are discharged into Lake Ontario.

II. CAYUGA, MONTEZUMA, AND OTHER MARSHES. — Around the lower end, and along the outlet of each lake, there are broad marshes, or tracts of low alluvion, which suffer inundation when the lakes are swollen by rains, or their waters driven to the north by southerly winds. The Cayuga outlet, which unites with the Seneca, before they unitedly join the Olydo, at Montezuma, has its whole course through a tract of marsh, which even begins in the lake itself. From Montezuma to the Onondaga outlet, twelve or fourteen miles, this marsh continues, preserving a width of two or three miles, and appearing, in summer, like an extensive meadow. There are, moreover, many detached swamps, and tracts of low, wet ground; so that the whole country, from the lower ends of the lakes to the shores of Ontario, between Great and Littleodus Bays, may be considered as participating largely in a paludal character, while the actual marsh is estimated at sixty thousand acres.† At the present time, after forty years of settlement, the extent of swampy surface within the Oswego Basin is greatly diminished; and many beautiful and flourishing towns, as Canandaigua, Geneva, Auburn, and Syracuse, have sprung up, to attest the salutary influence of cultivation.

The center of this district is in latitude 43°; the elevation of the marshes above the sea about three hundred and fifty feet; that of much of the surrounding country from one hundred to one hundred and fifty feet more. Let us inquire into the past and present state of autumnal health among its inhabitants. In 1792,‡ Doctor Coventry settled on the eastern bank of Seneca Lake, near its outlet, and opposite the now village of Geneva. The autumns of 1793 and 1794 were productive of a great amount of fever, which, however, was not often fatal. In the village of Geneva, there was, in the autumn of one of the early years of its settlement, but a single person not down with fever. "In 1795 no rain fell either in June or July — the waters of the lakes lowered more than a foot — every little inlet became a seat of putrefaction — the heavens seemed on fire, the earth scorched, and the air saturated with pestilence — hogs were found dead in the woods, and the flies swelled, turned white, and laid in handfuls on the floors of the rooms."§ In August, Doctor Coventry visited a family on the east bank of Cayuga Lake, where Aurora

\* New York Geological Report.

† Ibid.

‡ O'Reilly's Sketches of Rochester, 1838.

§ Ibid.



now stands. In one room he found the mother a corpse, and in another, the father and two children were down with the fever of which she had expired; the symptoms of which, as described to him, resembled those of yellow fever.

According to Doctor Ludlow,\* this region was chiefly settled from 1791 to 1804. From 1800 up to 1813 or 1814, intermittents and remittents prevailed every autumn, in all parts of the country; but after that time, to the date of his publication, in 1823, they were less constant in their annual epidemic recurrence. Of the year 1801, he says: "The diseases of spring and summer months were, principally, intermittent fevers, which prevailed throughout the country; they were of the tertian type. None were exempt from them, except those who had undergone many previous attacks, without having taken any measures to interrupt their course. In September and October, remittents of a mild form appeared."

In 1804, as Mr. Brown† wrote, the "Lake Fever" was of an intermittent type, and exceedingly prevalent, around the marshes of Oneida Lake. In the same year, President Dwight, on a tour through this region, says, in reference to its health: "The diseases which principally prevail here are the ague and fever, intermittents without ague, and billous remittents. Fever and ague may be considered as nearly universal; almost all the inhabitants being sooner or later seized by it, within a few years after their emigration."

Of the lake country generally, Doctor Reid, of Rochester, remarks, that in its early settlement, intermittent and remittent fevers prevailed to such an extent, that it was regarded as a 'valley of bones,' a premature burying-place.‡

When at Auburn, Doctor Pitney, who had settled on Cayuga Lake as early as 1808, informed me, that there was then a great prevalence, over the whole of that country, of intermittents, quotidian, tertian, and quartan, — cases of which now and then assumed a malignant character. Remittents prevailed, also, but to a limited degree; they continued to return annually, however, in an undiminished ratio, after intermittents had greatly abated.

It appears from these testimonies, that marshes from three to four hundred feet above the level of the ocean, in latitude 43°, can generate a great annual prevalence of autumnal fever, often assuming a fatal character. We have seen, however, that the swamps of the Chautauque summit, at the height of fourteen hundred feet, although a degree farther south, are innoxious. Such is the effect of elevation. When speaking of Fort Winnebago, west of Lake Michigan, it was stated, on the authority of our army surgeons, that autumnal fever is almost unknown at that post, though extensive marshes lie contiguous. The latitude of that post is 43° 31', its altitude eight hundred feet. Shall we ascribe the difference, in autumnal fever, between the two localities, to half a degree of latitude and four or five hundred feet of elevation? There is no other obvious cause, as both were newly-settled regions;

\* Inaug. Disc. 1823; embodying the experience of Doctors McNab, Carter, and Vandenburg, of Geneva, and Doctor Hays, of Canandaigua.

† Med. and Phil. Register, Vol. IV.

‡ O'Reilly's Sketches.

and yet the influence of altitude cannot be greater on the climate, than that of one degree of latitude; whence we may conclude that the Montezuma marshes lie near the northern limits of autumnal fever, at the elevation of three or four hundred feet, and that if, at the same level, they had laid a degree and a half farther north, that is, on the opposite declivity of Lake Ontario, in latitude  $44^{\circ} 30'$ , they would have been found comparatively harmless.

Let us turn to the influence of settlement, cultivation, and town-building, on the autumnal health of the region under review. All accounts concur in representing it as of the most favorable kind. Both intermittents and remittents, it is true, still occur, but with greatly diminished frequency, in the most insubrious localities; while they have nearly disappeared from many places where they formerly prevailed every autumn. From General Swift and Professor Webster, who came in 1827 to Geneva, on the high and dry western bank of Seneca Lake (where Doctor Coventry once saw all the inhabitants, except a single person, ill at the same time with fever), I learned, that when they arrived, intermittents still prevailed to some extent, but have almost entirely disappeared; a statement which was confirmed by Doctor Spenceer, junior, of the same city, as far as it relates to the rarity of their occurrence at this time. At Auburn, Doctor Pitney assured me, that within the range of his practice, intermittents are incomparably fewer, than in former times; remittents have also diminished in number, but not in the same ratio. From Doctor Briggs, of the same city, whose observations had been continued through a period of sixteen years, I learned that, for ten years after his arrival, in 1831, he did not see a case of intermittent; but since the year 1840, a re-appearance, to some extent, had taken place. Sporadic remittents have occurred every autumn. The vicinity of the Montezuma swamps, as in early times, is still most infested. At Manlius, Doctor Nims assured me, that the neighborhood of the marshes is much less scourged than formerly, while the disease is almost unknown in more favored localities, where it once existed. By Doctor Hoyt, of Syracuse, the site of which, near the head of Onondaga Lake, was originally a portion of its bed, converted into a white cedar swamp, I learned that, when he arrived, in 1832, there was very little intermittent fever, but latterly it seemed to be increasing. At Salina, two miles down the lake from Syracuse, I was told by Doctor Daniels, who had resided there thirty-two years, that, in former times, autumnal fever was incomparably more prevalent than in latter years. These testimonies may be regarded as sufficient to show the amelioration produced by the hand of art; but the perfect transformation of this region, although an easier task than if it lay farther south, will not be effected for a long time to come — perhaps never.

It is proper to state, that the Erie Canal traverses the swamps, and the whole length of the district which has been described. Of the effects of this excavation on the health of the laborers, after the lapse of nearly thirty years, no reliable information can be obtained; nor am I able to say, whether the excavation or the filling of the canal with water, in other and more salubrious

localities, was injurious to the inhabitants along its banks. From Doctor Trowbridge, of Syracuse, I learned, however, that, in the summer and autumn of 1846, intermittents prevailed generally *along* the canal, in its middle and western portions. Although most of the works of art, by which the wilderness is transformed into a settled and cultivated country, contribute, in the end, to its autumnal salubrity, it seems probable that canals do not.

I have treated the lacustrine portion of the Oswego Basin as a whole, but must say something of a few localities.

III. SYRACUSE AND SALINA. — The plain on which Syracuse is built, as the surrounding higher lands clearly indicate, was once covered by Onondaga Lake. Its elevation above the sea is four hundred and twenty-five feet. When settlements were commenced, it was still a swamp, overgrown with white cedars. It is now transformed into dry land; but the part which lies nearest the head of the lake is still marshy, and the waters of that part of the lake are shallow. The plain lies to the south-east of the head of the lake. Onondaga Creek enters it from the same direction, and passes through the town, where a dam converts it into a pool. The Erie Canal traverses the center of the town, where it is joined by a canal from the town of Oswego; both of which are expanded into basins, in which a vast number of boats are always to be found. Syracuse is a great salt factory. The water is evaporated by solar heat, from wooden pans, on a vast scale, in the western and southern edge of the town, while to its north-west, beginning among its houses, an immense quantity is boiled down by wood fires.

SALINA is situated on the northern side of the lake, two miles north-west of Syracuse, on higher ground, but has the marshy borders of a creek to its north-west. Here, also, immense quantities of salt are manufactured by culinary heat.

The etiological interest connected with these places (as far as autumnal fever is concerned) may be stated in the question, whether the manufacture of salt counteracts the influence of topographical conditions, in producing that form of fever? The effects of the manufacture on the atmosphere are twofold; *first*, by the liberation of a vast amount of caloric, and the generation of immense volumes of wood-smoke; *second*, the annual escape into the atmosphere of about two millions and a quarter of hogshheads of water in the form of vapor, carrying with it a minute quantity of salt. From all the information I could collect, autumnal fever has not diminished more in this locality than over the region generally, to which it belongs. Yet the testimony of Doctor Daniels and Lovejoy, and of Mr. Woodruff, salt inspector, the last of whom had resided in Salina forty-five years, was, that those who tend the furnaces and boilers, where they are immersed in a hot and humid saline atmosphere, suffer less from intermittent fever than those who, by their occupations, seldom come into the heated atmosphere. In visiting the pans for solar evaporation, on the western bank of Onondaga Creek, where the families of the tenders reside, I was told that their chief disease was intermittent fever. The conclusion from these facts must be, that saline vapor does not counteract the cause of intermittent fever, but that culinary fire — a heated atmosphere —



although it may be humid, does exert a correcting influence. This, perhaps, is one reason why that disease disappears from the central parts of all our towns and cities, and suggests a preventive measure to those who live in marshy places.

IV. Oswego. — This town, the largest on the southern coast of Lake Ontario, stands on both sides of the mouth of Oswego River, which approaches the lake with a bolder current than most of its tributaries. The estuary is bordered on both sides by high Silurian sandstone banks, overspread with drift. The town itself is built on two rocky slopes, which rise, on either side, from the water's edge to the height of one hundred and fifty to two hundred feet. To the north-east, beyond the limits of town-settlement, there is a depression, which appears once to have been a swamp. On the shores of the lake there is no marsh. *Fort Ontario* stands on a bold promontory immediately below the junction of the river with the lake. Marsh-exhalation, at this place, seems to be at a minimum; but the aqueous vapor abounds, for there is a canal, which supplies a vast number of mills with water, taken from the river above; and their agitation of it promotes evaporation; while the ceaseless dashing of the waves of the lake, against the rocky natural and artificial buttresses of the harbor, contributes to the same result. If it be a fact, that paludal streams absorb poisonous gases, and give them out under mechanical agitation, no spot could be found where that liberation would more certainly take place; for this is the *embouchure* of the river which drains all the marshes of the region we have been surveying; and those portions of its waters which escape agitation by the wheels of its numerous mills, are subjected to it as they enter the lake. The latitude of Oswego is about  $43^{\circ} 25' N.$ ; the elevation of the surface of the river, and that of the lake, two hundred and thirty-one feet above the sea; that of the town ranges from the water's edge up to three hundred feet above. A trading-house was established here, as far back as 1722; and, five years afterwards, a military post. Thus, the settlements here are of a much older date than those in the basin of Oswego River, and the soil has been exposed and stirred for a much longer period. Such a locality, in such a latitude, might be expected to be almost exempt from autumnal fever; but that is not the case; yet its prevalence, on the whole, is less than in the paludal region above — less, for example, than at Syracuse. The years 1828 and 1829 are remembered by Doctor Hart and Doctor Hard as those of its greatest prevalence. The whole country was then affected. For the next fifteen years, it was only sporadic; but from 1844 to 1847, it became more prevalent. The sailors of the port are more subject to the intermittent form — the people of the town to the remittent.

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## SECTION VI.

### BASIN OF BLACK RIVER.

I. The coast of Lake Ontario, from Oswego River round to the St. Lawrence, is loamy, and sufficiently elevated to escape inundation from changes

of level in the lake. The only stream of considerable length or volume is Black River, which enters the small bay on which it confers its name, at Sackett's Harbor. The sources of this river interlock with those of streams which flow into Oneida Lake, and into the Mohawk and Hudson Rivers. The Adirondack mountains limit the basin of this river to the east; the tributaries of the St. Lawrence to the north. The utmost sources of Black River are in a primitive formation; but lower ones are found in swamps, which impart to its waters the hue that has suggested its name. Other sources still, are in small lakes, lying on the plain which stretches from the base of the Adirondack Mountains to Lake Ontario and the St. Lawrence River. The river descends to the lake by a series of levels and precipices. Its alluvial grounds, after leaving the mountains, are broad. Its mean latitude is about  $43^{\circ} 45'$ . This part of the Ontario Basin is thinly peopled, and so little known that I can say nothing of its autumnal fevers.

II. SACKETT'S HARBOR, AND MADISON BARRACKS. — Both the town and barracks stand on a thinly covered bed of old Silurian limestone, which, appeared to me nearly identical with that of Cincinnati. Black River enters the bay a short distance to their north. There are no marshes in the vicinity of either. The grounds around the garrison are so level, that they cannot be perfectly drained. The soil is dark, with much clay, and rests on a stratum of limestone, which is from one to three feet below the surface. The nature of the soil, and this superficial calcareous stratum, keep the immediate vicinity of the post, even after ordinary rains, boggy, and favoring terraqueous exhalation. The physical aspect of the surrounding country is waving and undulating. The soil is generally rich.\*

The returns from the post, for four years, show a prevalence of intermittent fever to the amount of twenty per cent. per annum, of remittent, three per cent. The last year of these returns was 1838. The next year, 1839, presented more autumnal fever than had been known previously; and the people of the village suffered more than for twenty years before. The fever occurred, also, in the surrounding country.

This is all that I can say of Sackett's Harbor; and with it we close the survey of the southern side of the basin of Lake Ontario, comprising western New York. In proceeding with the northern half, we shall return to the mouth of the Niagara River, and travel round the lake to the outlet of the St. Lawrence, near which stands the town and barracks which have just been noticed.

## SECTION VII.

### COAST OF LAKE ONTARIO, FROM NIAGARA RIVER TO BURLINGTON BAY.

I. The Mountain ridge through which the Niagara has cut its deep and narrow trough, from the Falls to Queenstown, is distant from the lake about

seven miles; but fifty miles to the west, at the head of Burlington Bay (the western extremity of the lake) it approaches much nearer. From this high-land range many short streams descend, and, traversing the lower belt between it and the lake, pour their torrents into that receptacle by estuaries, in which its agitated waters flow and ebb, and along which there are swampy regions. In general terms it may be said, however, that this portion of the lake coast, till we reach Burlington Bay, is less infested with swamps than some other parts. Its latitude is about  $43^{\circ} 15' N.$ ; its elevation above the sea, from two hundred and thirty-one to three hundred and fifty feet. In addition to the creeks which have been mentioned, it is traversed by the Wolland Canal, which reaches the lake at Port Dalhousie.

II. NIAGARA AND FORT MISSISSAUGA. — The Canadian town of Niagara stands near the junction of the Niagara River with Lake Ontario, opposite the American Fort Niagara. The town faces on the river, but the fort is more immediately connected with the lake, over which the bank is so elevated, as not to be inundated by the highest swells of the lake; but the soil is argillaceous, retentive of moisture, and, to the west of the town and fort, there is a considerable extent of swampy ground, particularly along Four Mile Creek.\* The army returns do not instruct us as to the prevalence of autumnal fever in this locality; but, as Niagara has been recommended as a place of summer resort, we may conclude that it is but little infested with that disease; and this conclusion is supported by Doctor Melville, who informs me, that, after residing there a year, he had seen none of that fever, and was assured by the inhabitants, that both the village and its neighborhood have been, at all times, remarkably exempt. Niagara has been settled a long time; and to this we may, perhaps, in part, ascribe its alleged autumnal salubrity.

III. ST. CATHARINE'S. — This town, the population of which is three thousand five hundred, stands twelve miles west of Niagara, on the Wolland Canal.† It belongs to the lower belt or level, but is distant several miles from the lake shore, and has the mountain ridge in its rear. From Doctor Mack, who has resided five years in this place, I learn that autumnal fever is more prevalent in the township of Grantham, of which St. Catharine's is the principal town, than in Niagara. "My experience at this place," says he, "extends through five years, during which, every autumn has been productive, in paludal spots, of a greater or less number of sporadic cases of intermittent and remittent fever, having a typhoid type. Once only, 1846, a mild remittent was epidemic. Between St. Catharine's and Niagara there is a long flat, on and near which there is generally a great deal of autumnal and vernal fever. The settlements along the immediate shores of the lake suffer every year with intermittent and remittent fevers and neuralgias. The Wolland Canal, by its leakage, supplies moisture to favor the decomposition of organic matter. In one place it passes through a tamarack swamp, and

\* Tulloch's Statistics of the British Army.

† Smith's Canadian Gazetteer.



there the wretched laborers, and other inhabitants, exhibit a pallid and sallow hue of countenance; the females are generally anemic; and the latter end of September and beginning of October, always pass off with great mortality from typhoid affections. This has been the case, even when other parts of the country were quite healthy. Sometimes a violent dysentery prevails among the people living on the mountain ridge, while intermittents and remittents prevail in the lake belt below."

IV. BURLINGTON BAY: HAMILTON: DUNDAS. — According to Doctor Bigsby,\* Burlington Bay, constituting the western beak of Lake Ontario, is itself a small lake, communicating with Ontario by a creek running through a high sand reef. A canal has been dug through this bar. Around the extreme termination of the bay, there is an extensive marsh, through which the Desjardins Canal, five miles in length, extends up to the town of Dundas; which stands in a cove, or retreating angle of the mountain ridge. The larger town of HAMILTON, which was commenced in the year 1813, lies five miles from Dundas, on the south side of the bay. On account of a swampy margin, the principal part of the town stands a mile from the bay, in rising ground, closely embayed by the mountain ridge, which here ranges at the elevation of one hundred and fifty feet above the town.† To its east there are a few marshy inlets. By Doctor Craigie, of Hamilton, I am informed that Dundas, standing to the windward of the marsh, is healthier in summer and autumn than Hamilton, the sickliest portion of which is the western, which is most exposed to the swamp. By his meteorological observations, it appears that the westerly winds which waft the paludal exhalations from Dundas, and carry them over Hamilton, prevail about three hundred days every year. The type of fever is both intermittent and remittent. The latitude of this locality is about 43° 12' N.; its elevation above Lake Ontario, from two hundred and thirty-one, up to two hundred and fifty feet. In advancing westwardly from the bay, we soon reach the Basin of Grand River, described in the last chapter.

## SECTION VIII.

### COAST AND BASIN OF LAKE ONTARIO, FROM BURLINGTON BAY TO THE VALLEY OF THE TRENT.

I. The mountain ridge which presses so close on Burlington Bay, there leaves the lake, and, stretching off to the north, reaches the lower extremity of Georgian Bay, of Lake Huron. West of this ridge is the valley of Grand River of Lake Erie, already described. To the east, as far as the valley of the Trent, more than half the length of Lake Ontario, the northern basin of that lake is reduced to a width of thirty or forty miles; and the little streams which traverse it to the lake, interlock in their origins with the

\* Topography and Geology of Lake Ontario.

† Smith's Canadian Gazetteer.

waters of Lake Simcoe, and the south-western tributaries of the Trent. Compared with its counterpart, on the south side of the lake, which is the basin of Concession River, this district has but little breadth. Its surface-geology is very remarkable. Starting from the lake shore, and exploring it directly north, the observer passes over a series of post-tertiary steppes or terraces, rising above each other, at unequal heights, and exhibiting various breadths of surface. In all, there are eleven ridges of this kind, and the last and highest is six hundred and eighty feet above Lake Ontario; consequently, nine hundred and eleven above the sea. Beyond the summit-level, an obscure terracing of the same kind leads down to Lake Simcoe, the superfluous waters of which reach Lake Huron through the Severn, by a descent of one hundred and seventy feet, and consequently that lake has an altitude of seven hundred and forty-eight feet above the sea. The remarkable amphitheater of natural benches which has been indicated, is composed of clay, sand, and gravel, supporting granitic bowlders from the north. On many of the terraces there are swamps, but large portions present a sandy soil, overshadowed with pines, which, moreover, are sparsely scattered over every part. Several little rivers, or long creeks, cut through these terraces, and make their way to the lake, of which I may mention the Credit, Holland, Rouge, Humber, and Don. The rapid descent necessary to bring them from so high a level, in so short a distance, appears to have prevented the formation of wide and low bottoms. The latitude of this district extends from  $43^{\circ} 16'$  to  $44^{\circ}$  N.\* Excluding, for the present, the lake shore, it may be stated that the region which has been so briefly sketched out, does not suffer much from autumnal diseases. Its being among the best settled portions of Canada West, is, of itself, an evidence in its favor, while its latitude, elevation, and sand-terrace, pine aspect, would suggest the same conclusion. It is not, however, wholly exempt from both intermittents and remittents, which, as Doctor Rees, of Toronto, informed me, occur more or less every year, up to the summit-level of the district, in latitude  $44^{\circ}$ , and at an elevation of nine hundred feet above the sea.

II. The coast, from Burlington Bay to Toronto, a distance of forty miles, presents nothing very peculiar. Portions of the terrace are sandy, down to the water's edge, and bear pines; but, as Doctor Nicol, of Toronto, informs me, the estuaries of Credit River, the Humber, and several smaller streams, are bordered with swamps, which, in summer and autumn, give origin to intermittent and remittent fevers, which sometimes become epidemic. The mean latitude of this coast is about  $43^{\circ} 20'$  N.

III. CITY OF TORONTO. — The most populous and important city on the northern, or, indeed, either coast of Lake Ontario, is Toronto, in N. Lat.  $43^{\circ} 39' 4''$ , and W. Lon.  $79^{\circ} 21' 5''$ . Commencing near the level of the lake, at an elevation of two hundred and thirty-one feet, the plain on which the city is built rises gradually to the height of one hundred and eight feet. The

\* Bligny: *Topography and Geology of Lake Ontario*. — Lyell: *Travels in North America*. — Murray: *Canadian Geological Reports*. — Smith: *Canad. Gaz.*

greater portion of the population reside at an elevation of about two hundred and fifty feet above the sea. Above the town, to the west, the immediate bank is higher, and also rises more rapidly from the water. On this part of the terrace, to the south-west of the center of the city, and near the lake, are the fort and barracks. A few miles further, in the same direction, to the summer and autumnal-windward, is the estuary of Etobicoke, a small river. To the north, a second terrace, twenty or thirty feet higher than the first, succeeds, and may be regarded as the second of the series of terraces just described. Adjacent to the city, to the north-east, are the low and swampy bottoms of the River Don; which, however, are of no great extent. Immediately to the east, beyond the mouth of that little river, a sand-bar projects from the shore, to the south, and, curving round by the south-west, terminates in Gibraltar Point, below the town, thus forming the harbor. The surface of this bar rises but little above that of the lake, bears some grass and scattering trees, and has a number of small swamps and ponds, which lie to the south of the city. Several docks project into the harbor, from two to four hundred feet, and present the usual aspect of filth and decaying wood. These accumulations are the greater, because the bar to the east prevents the movement of the waters in that direction by the westerly winds. In examining portions of the town-plot, from which the trees had been recently cut down, I found the ground wet and boggy. Such is the medical topography of Toronto. Its settlement began under the name of Little York, near the close of the last century; but its present estimated population, twenty-five thousand, is the result of a rapid growth within the last few years; so that, in fact, it is still a new town, and the soil of its environs but in the process of transformation. Toronto seems at all times to have been subject to autumnal fever, especially in the intermittent form. More than thirty years ago, the population being about six hundred, when the ponds and swales of the plain on which the town was built were but partially dried up, and the vicinity was still in a state of nature, Doctor John Douglas, of the British army, found intermittent fever prevalent.\* Doctor Taylor, surgeon of the 81st Highland regiment, whom I saw in Quebec, was stationed for several years at this place, and during that time, a regiment arrived from England, of which a large proportion suffered from intermittent fever; while of another which came from the West Indies, nearly all escaped that disease; — a fact that deserves to be remembered. As to autumnal fever, at the present time, I learned from Doctor Rees, that both intermittents and remittents are common, especially on, or contiguous to, the low grounds in the vicinity of the city, near the small rivers which have been mentioned. By Doctor Nicol I have been informed, "that both intermittent and remittent fevers are very prevalent in Toronto, and along the neighboring coast, especially near the mouths of the Don, the Etobicoke, the Humber, and the Credit Rivers, where there are extensive marshes. In spring and autumn, nearly one half the cases of disease relieved at the Dispensary, are intermittents. Both

\* Edinburgh Med. and Surg. Journal, Vol. XVI.



variation of autumnal fever occur every year, but are much more prevalent in some years than others. They assume, at times, an epidemic character. Intermittents generally prevail more than remittents. Simple ague is most commonly met with — malignant intermittents are rare. The adynamic, or malignant form of remittent, is common near the mouths of the Humbor and the Credit Rivers — in a less degree near that of the Don. It is called by the people the *Lake-fever*, and is often confounded with typhus. It is the most dangerous form of autumnal fever. On the stoppes or terraces north of Toronto, inflammatory intermittents have prevailed to a considerable extent of late, where, formerly, intermittents in any form were by no means very common. In many cases, the inflammatory excitement of some organs masks the true character of the disease."

IV. THE COAST, FROM TORONTO TO THE EMBOUCHURE OF THE RIVER TRENT.  
—At the distance of six or eight miles east from Toronto, there commences a tract of highlands, which rise from two hundred and fifty to three hundred feet above the lake. They are composed of drift, or post-tertiary materials, of the same kind with the terraces north of Toronto. Their summits, and the country in their rear, support pines. At their base, near the lake, there are extensive marshes, which extend up every little stream. These high bluffs at length decline into a bank of the same composition, from sixty to eighty feet in height, which continues eastwardly, and embays the new towns of Port Hope and Coburg, in the vicinities of which, as along the coast generally, there are marshes.\* The latitude of this coast is a little below 44°. I regret that I cannot state the extent to which it is infested with autumnal fever.

## SECTION IX.

### BASIN OF THE TRENT, AND THE BAY OF QUINTE.

I. We have seen that the middle portion of the Southern Basin of Lake Ontario is essentially lacustrine — no less than eleven small lakes discharging their superfluous waters through the Oswego River. It is somewhat remarkable, that the corresponding locality on the opposite or northern side of Ontario, equally abounds in small lakes, which, by their confluence, form a river, the *Trent*, which, like the Oswego, takes an eastern direction. Unlike that river, however, it does not perforate the side of Ontario, but pours its waters into the head of a long, zigzag appendage of the lake, called the Bay of Quinte, which bears a relation to this lake, very like that of Green Bay to Lake Michigan, or Georgian Bay to Lake Huron. The axis of this bay and of the River Trent is the same, and, continued to the south-east, terminates in Lake Ontario, not far from the efflux of the River St. Lawrence. The same axis prolonged to the north-west, ends in the head or southern extremity of Georgian Bay; showing that the time was, when the latter might

\* Higaby.

have extended, or sent a river into Lake Ontario, near its lower end. Throughout its whole extent the Basin of the Trent is connected, on the south, with short streams, which flow directly to Lake Ontario; on the north, with the tributaries of Ottawa River, which joins the St. Lawrence near Montreal. The larger of the lakes within the Trent or Quinté Basin, are Skugog, Balsam, Sturgeon, Pigeon, and Rice. The geological basis of this basin is Silurian limestone, and other rocks of that era; but the surface is deeply overspread with drift, or post-tertiary deposits; which, in some places, are arranged into steppes or terraces, but not so distinctly as in the region north of Toronto.

According to Doctor Bigsby,\* the River Trent flows rapidly over a shallow and rocky bottom, between high banks, through a beautiful country of steep hills and luxuriant valleys; and, around the Bay of Quinté there are many hills and cliffs; yet, as the same observer states, there are morasses. Some parts of the bay coast are marshy; but it does not appear that the borders of the river and its tributaries, are particularly liable to inundation. Much of the soil is sandy, and supports an intermingled growth of pine and oak.† The whole basin is included between the forty-fourth and forty-fifth parallels of latitude—its mean elevation may be taken at four hundred feet above the sea.

II. North of this basin there are low mountains, with primitive rocks, and the country, up to Hudson's Bay, is in a great degree uninhabited. Of the prevalence of autumnal fever within the basin, I can say but little, for want of information. Its hydrography suggests, that the topographical conditions requisite to the production of that fever in a lower latitude are not wanting; and the only specific account I have obtained, shows that the fever is not absent from the lower and southern part of the basin. Doctor Vanduyk, now of Oswego, New York, who resided ten years in the townships of Ernestown and Thurlow, west of Kingston, and north of the Bay of Quinté, met with that fever every year; and in 1828 it assumed something of an epidemic and even malignant character; for he saw several cases of algid and soporoso intermittent. His latitude was  $44^{\circ} 10'$ —elevation above the sea about two hundred and fifty feet. Compared with Fort Howard, at the head of Green Bay, where the topography is highly favorable to the generation of autumnal fever, and yet it is almost absent, we are led to seek for the causes of the difference between that locality and this. They appear to be two—a difference of half a degree in latitude, that being in  $44^{\circ} 40'$ ; and of three hundred and fifty feet of altitude, that being five hundred and ninety feet above the sea.

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\* Phil. Mag. and Ann. of Phil., Vol. V.      † Canad. Gaz.

## SECTION X.

## K I N G S T O N .

The old French fort, *Frontenac*, now the town of KINGSTON, was established nearly two hundred years ago. It stands in N. Lat.  $44^{\circ} 8'$ , and W. Lon.  $76^{\circ} 40'$ , on the north, or left bank of the outlet of Lake Ontario, and, therefore, at the head of the St. Lawrence River, on a slope which rises gradually from the water's edge to the height of seventy feet, or three hundred above the sea. The basis of this slope is old Silurian limestone, which seems to be almost identical with that which forms the site of Nashville, Tennessee. We are here on the northern margin of the transition formations; for immediately beyond Kingston, primitive rocks, *in situ*, make their appearance; and, stretching in a zone from the north side of Lake Ontario across the St. Lawrence, form the THOUSAND ISLANDS, and terminate in the granitic Adirondack Mountains of New York, west of Lake Champlain. Immediately east of the town lies the small Cataraugui Bay, in which a little river of the same name, and the Rideau Canal, from Ottawa River, terminate. The water of this inlet is turbid. In one of its curves or indentations, on the north-eastern side of the town, I found it skirted with low, foul, alluvial ground. In the water there were several decaying docks; and between, or near them, rafts of timber, on which weeds were growing. The water around was evidently the receptacle of a great deal of street, kitchen, and cellar filth, sent out from the numerous small and old houses, inhabited chiefly by poor Irish families, making up the mass of the population in that quarter of the town. This was the only source of insalubrious exhalation which I saw, in connection with the plat of the town; which has but a slight covering of soil, and a declivity of its rocky surface, favorable to cleanliness. On the eastern side of the little bay there is a rocky promontory, one hundred and fifty feet high above the lake, on the extremity of which — once the site of old Fort Frontenac — now stands *Fort Henry*. A mile to the west of the town, a long narrow peninsula, called Point Frederick, stretches into the lake; the ground in the vicinity of which is swampy, and the water around it shallow, stagnant, and muddy, with deposits of decaying vegetation.\*

Both intermittent and remittent fevers, but especially the former, prevail annually at Kingston. This is manifest from the returns of the British army; but these diseases prevail less among the troops stationed in Fort Henry, than those which are quartered in the town, on the bank of the little bay which separates them. In a visit to his hospital, on the 8th of September, 1847, with Doctor McIntosh, who had charge of one hundred and twenty artillerymen, five of the patients had intermittent fever, contracted in the town; and Doctor McIntosh seemed familiar with the disease, as one annually occurring in Kingston. Doctors Sampson and Robinson, also, testified to the frequent occurrence of both forms of autumnal fever, among the citizens of the place.

\* Tullock's Stat. Rep. of the British Army.



Kingston, when compared with Jamestown, near Chautauque Lake, affords an instructive illustration of the influence of altitude in limiting autumnal fever. The topographical conditions, in reference to the production of that fever, are not materially different, and Jamestown is two degrees farther south; yet, from its greater elevation of eleven hundred feet, it is almost entirely exempt.

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## CHAPTER XV.

### THE EASTERN, OR ST. LAWRENCE BASIN, CONCLUDED.

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#### SECTION I.

#### THE RIVER ST. LAWRENCE, FROM LAKE ONTARIO TO THE ISLAND OF MONTREAL.

I. THE great natural canal, by which the superfluous water of all the lakes, with their confluent streams, over which we have passed, flows off to the Gulf of St. Lawrence, has its broad beginning in the northeastern corner of Lake Ontario, but a short distance below Kingston. For the distance of about sixty miles its current is so gentle that it almost seems a mere arm of the lake. The "*Thousand Islands*" are found in this intermediate section, between the lake and the river proper. They are composed of granite and other primitive rocks. At length, the waters are collected into a single channel, and, moving with increased velocity, present the aspect of a true river; which differs from most others in the Interior Valley, by the uniform elevation of its surface and the equally constant transparency of its waters. Its banks, consisting largely of drift or post-tertiary deposits, are sufficiently developed, and so firm as to be but little acted upon by its gentle current. In many places the stream divides and incloses portions of the bank, in the form of islands, which of course are not subject to inundation. The lower half of the distance to Montreal Island, affords many bold and impetuous rapids; and above the island there are expansions of the stream, which have received the names of Lake St. Francis and Lake St. Louis; the shores of which, in some places, are low, alluvial, and marshy; while along the river, generally, wherever a tributary enters, there is more or less of swamp. The affluent streams, however, are not numerous, and the whole are small.

II. TOPOGRAPHY OF THE COUNTRY ON THE SOUTHERN SIDE OF THIS SECTION OF THE ST. LAWRENCE.—The basin or valley of the St. Lawrence, on its southern side, has no great breadth, and is terminated by the Adirondack Mountains of Northern New York, which may be seen, as blue mounds in the horizon, in descending the river. These mountains constitute the culminating dome of the streams which flow into the St. Lawrence, on the north; into Lake Champlain, on the east; into the Hudson and Mohawk, on the south; and into Lake Ontario, on the west. The same mountains have numerous small lakes, at the height of fifteen or eighteen hundred feet.\* The streams which descend from them to the St. Lawrence are cold, transparent, and inhabited by trout. The principal are the Oswegatchie, Indian, Racket, Grass, St. Regis, and Salmon. Even these, however, are of moderate length and volume; for the belt of country which they traverse is narrow, compared with its length. They abound in falls and rapids. Some of them originate in swamps, which impart to their waters a darkish hue. The lower and flatter portions of this region are less lacustrine than the higher. Indian River expands into Black Lake near Ogdensburg, and then joins the Oswegatchie. Near the St. Lawrence the general aspect of this region is level, or terrace-like, and rolling, with tracts of woodless plain. It then becomes hilly, and at last mountainous. Its lower or northern extremity, constituting a sort of peninsula between the St. Lawrence and Lake Champlain, is chiefly a dead level, and but little elevated above the water. The underlying rock of this tract, in its southern part, is granite,—near the river, old quartzose sandstone, and other transition rocks. The surface abounds in drift, or post-tertiary deposits, supporting granitic bowlders, which lie at the base of these mountains; from which, in the opinion of Mr. Hall,† the erratic blocks of primitive rock, found in the south-west, down to the banks of the Ohio, were transported.

III. OGDENBURG.—This is the most important town of the region we are surveying. Its position is immediately below or east of the mouth of the Oswegatchie River, on a high bank of the St. Lawrence, overspread with, or composed of, drift, resting on the oldest Silurian rocks, from which, near the town, the water falls, in rushing the St. Lawrence. On the opposite or western side of this little river, the bank, by two terraces, attains even a greater elevation than the plain on which the town is built, and has the same composition. Near the junction of the two rivers are several acres of alluvial ground, part of which is perpetually covered with water, while the whole is liable to inundation from floods in the Oswegatchie. A short distance from its mouth, there is a dam, creating a pool, in which a vast number of 'saw-logs,' floated from the interior, are constantly accumulated. From this pond, mill-races pass through the alluvial ground.

Doctor Sherman came to Ogdensburg in 1825, when it was still a newly-settled locality, and found autumnal fever prevailing. In the following year it was universal, extending to both sides of the St. Lawrence, up and down

\* New York Geological Reports.

† Geological Report of the State of New York; Second and Fourth.

the river; also, around Black Lake, which lies a few miles from the St. Lawrence, and along all the small streams,—invading, in a mitigated degree, even the highest and driest ridges and terraces. In 1827 and 1828 it recurred, but with less violence; and then ceased until 1835 or 1836, when a slight invasion was experienced. Again it disappeared until 1845, when cases occurred, followed, in the two next years, by others. Its type was both intermittent and remittent—in the recent invasions the remittent form predominating. The testimony of Doctor Laughlin, who arrived in 1836, corroborates, as far as it goes back, that of Doctor Sherman. In 1840, he saw it occurring in surrounding localities, where it was said not to have appeared before. He had formerly lived twenty miles south-east of the St. Lawrence, in a broken country, where the fever did not occur.

In comparing this locality with Green Bay, the latitude of both being  $44^{\circ} 40' N.$ , we find the topographical condition of the latter decidedly more fitted to produce autumnal fever than that of the former; and yet the disease has prevailed to a far greater extent here than there; a difference which may be referred, perhaps, to the difference of three hundred and fifty feet in their altitude. If we extend the comparison to Fort Winnebago, one degree and ten minutes south of Ogdensburg, but five hundred and seventy-five feet higher, the evidence is still more conclusive; for, while the topographical circumstances at that post are more favorable to the origination of the fever, its prevalence is less. Again, when we compare Fort Snelling, at the junction of the St. Peter's and the Mississippi, we have evidence of the same kind. That post is only thirteen minutes north of Ogdensburg, but five hundred and twenty feet more elevated, and autumnal fever occurs in the most limited degree only, notwithstanding the topography might favor its production.

Of other localities within the region, the outlines of which have been sketched, I cannot speak, for want of information.

IV. THE NORTHERN BANK OF THE ST. LAWRENCE, FROM THE LAKE TO MONTREAL.—This is a long and very narrow belt, traversed by short and inconsiderable streams. Narrow as it is, however, it embraces a number of small lakes. The immediate bank of the upper part of this section of the river is high and dry, and does not, like the banks of the Ohio, decline from its margin, but becomes, in many places at least, still higher, as we go back from the river. Its geological constitution is the same as that of the region just described.

V. PRESCOTT.—The town of Prescott stands opposite Ogdensburg, in N. Lat. about  $44^{\circ} 45'$ . It is built on a limestone slope, its site inclining to the river, and well-drained. A mile in its rear there is a swamp now partly cultivated. Doctor Scott, who had resided many years in the town, declared to me, that intermittent fever had not originated either in the town or around the swamp. According to Doctor Sherman, of Ogdensburg, however, cases occurred here in 1826, when the disease assumed an epidemic character at Ogdensburg. Remittent fever, Doctor Scott informed me, now and then presents itself.



The first rapids of the St. Lawrence occur four or five miles below Prescott and Ogdensburg.

## SECTION II.

### BASIN OF OTTAWA RIVER.

I. Ottawa River, the largest tributary of the St. Lawrence, has its principal sources about N. Lat.  $48^{\circ} 30'$ , and W. Lon.  $70^{\circ}$ , where they interlock with those of the lake and river Abitibi, of Hudson Bay. At first, it runs west of south for two hundred and fifty miles, when it enters Lake Temiscaming; whence it sweeps to the south-east, through a region of lakes, ponds, swamps, and forests; expanding, contracting, dividing, re-uniting, moving quietly on long levels, and descending in cataracts or rapids, until it joins the St. Lawrence at Montreal Island, after running a course of between six and seven hundred miles. It receives the waters of many tributaries, both from the north and the south, and may be said, in general terms, to drain all the northern and middle portions of the region between Montreal and Lake Superior, up to the waters of Hudson Bay. Its basin comprehends about eighty thousand square miles.\* Above Lake Temiscaming, situated on an expansion of the river called Grand Lac, the Hudson Bay Company have a post; and another on that lake in N. Lat.  $47^{\circ} 10'$ , and W. Lon.  $70^{\circ} 31'$ , at the altitude of six hundred and thirty feet above the sea.

The Ottawa is to the St. Lawrence, in one respect, what the Alleghany is to the Ohio. It passes through pine forests, and most of the people who inhabit or labor on its banks, are engaged in the lumber trade. For about one-third of the distance from its mouth to its source — that is, as far up as the mouth of its largest tributary, the Madawaska, which flows from the south-west — it passes through a country tolerably well settled; beyond that point the settlements are thin, and, at length, cease altogether. In general, its banks are low, broad, alluvial, and subject to inundation.†

II. Bytown, the only important town within the Ottawa Basin, stands on the right bank of the river, at the distance of one hundred and five miles from its mouth. Adjoining the town there is a garrisoned fort. The elevation of the river, below the falls, which are near the town, is one hundred and eight feet above the sea. There are here, in fact, two towns — the older, on lower ground, and the newer, a mile farther up the river, on a higher terrace. The fort stands between them, and a canal to Lake Ontario starts from between them. The population of Bytown is seven thousand. About one-third of the people of the lower town are Canadian French, the remainder chiefly Irish.‡ As this locality is near the latitude of  $45^{\circ} 30'$  N., I regret not being able to state in what degree it is affected by autumnal fever; nor

\* Canadian Geolog. Survey.

† Smith's Canad. Gaz.

‡ Martin's Brit. Col.

am I informed to what extent that fever prevails along the river above the town.

III. THE RIDEAU CANAL.—This canal, which connects Bytown with Kingston, is largely a slack-water improvement of Rideau River, passing through the lake of that name and some others. "Thousands of acres of land have been flooded by the damming of the river to form the canal, and immense quantities of timber have been consequently destroyed. Great numbers of trees are still standing, dead, and surrounded by water, and give those portions of the banks of the canal a decayed, deserted, miserable appearance."\* From Doctor Nichol, of Perth, I learn that the region near the middle portion of this canal abounds in swamps and small lakes, with a prevailing sterility of surface. Its latitude is about  $45^{\circ}$ . Intermittent fever occurs every summer, and has been epidemic twice, in the years 1820 and 1847. In the former, the healthy were not in sufficient number to look after the sick: in the latter, which occurred in harvest time, the prevalence of the fever was such as to interfere with the labors of the season. This is the first locality, in the latitude of  $45^{\circ}$ , in which we have met with such epidemics. Its elevation above the sea is probably about three hundred feet. Remittent fever is exceedingly rare, especially in its malignant or congestive form.

IV. THE OTTAWA RIVER, BELOW BYTOWN.—Doctor McCullough, of Montreal, who resided ten years on the banks of this portion of the Ottawa, assured me that intermittents and remittents were unknown along the river, for a distance of more than thirty miles, over which his observations extended. Nevertheless, Doctor Calder, who resides at Lachine, Montreal Island, informed me that he had seen cases of intermittents from that river, but could not say in what part of its basin they were contracted.

## SECTION III.

### ISLAND AND CITY OF MONTREAL.

I. THE ISLAND.—The map of the Island of Montreal (*Pl. XVI*) will render an extended description unnecessary. Much of its surface presents a low platform of pebbles, and other transported materials, resting on transition limestone, and covered with productive soil, greatly incumbered, in many parts, with erratic blocks of primitive rock. There are, however, ridges, or *coteaux*, composed of transported materials, which rise to the height of one hundred feet, or more, above the general level of the island. A plateau of this kind traverses the southern part of the island, running south-west and north-east, from near Lachine to the center of the city of Montreal. That part which penetrates the city, is, however, but a kind of isthmus, or narrow cape; for an excavation has been made by ancient currents, so as to form a hollow or valley through the north-west part of the city. In this depression

1911

Coughin's

St. Louis

ISLAND

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## MONTREAL

**ZAGREB**

Scale 4 miles to 1 inch

From Marsh's Map of Canada

Place p 118.

C. J. Butler U.S.C. King





a small wet-weather stream still flows, and in former times there was, along it, a considerable extent of swampy ground, rendered foul by filth from the town. In looking from this terrace between Montreal and Lachine, to the south upon the lower platform through which a canal passes, several spots appear to be swaly. High diluvial terraces of the same kind are found on other parts of the island, but its coasts generally are low and flat, and those of its western extremity, above Lachine, are sometimes overflowed by floods in Ottawa River, or from the force of westerly winds acting on the waters of the Lake St. Louis, an expansion of the St. Lawrence. Lastly, in the rear of the city, stands the noted mountain of Montreal, the height of which according to Captain Bayfield \* is seven hundred and sixty feet above the river, and seven hundred and seventy-eight above the sea. This mountain is composed, in its lower parts, of old Silurian limestone, through which a great mass of green stone has been projected, and forms its upper part, which is divided into two summits.†

Lachine is an old French village, formerly the emporium of the fur-traders and *voyageurs*. It stands on a low rocky shore, nine miles west of the city; where there is an extensive basin to supply the canal, the bottom of which presents strata, changed from a horizontal to a nearly vertical position; an effect produced, no doubt, by the same force which throw up the green-stone of the mountain. Opposite the island, are the last rapids of the St. Lawrence.

II. MONTREAL.—The city stands on the south side of the island, in Lat. 45° 31' N., and Lon. 73° 34' W. It was settled by the French as far back as 1642; and came into the possession of Great Britain one hundred and twenty-one years afterward. Its population may be estimated at thirty-five thousand,—composed of Canadian-French, Irish, English, and Scotch, with a few from Germany and the United States.

Montreal is built on two terraces. The lower, lying next the river, presents at its margin the finest permanent wharves, of any city in the Interior Valley. The upper, which is not many feet higher, has but little breadth, and in its rear there is a depression or hollow, in which a sluggish brook was originally skirted with narrow swamps. Immediately beyond it is the base of the mountain. The canal from Lachine enters the St. Lawrence through the edge of the city, to its south. For a long time after the settlement on this spot, much of the island,—even places within the limits of the town,—had not yet been subjected to those transformations which cultivation and public hygienic labors effect. Thus, within the memory of the present inhabitants, as Professors Holmes and Hall informed me, the hollow, of which I have spoken, then in the rear of the town, but now almost in the heart of the city, was in a condition which occasioned intermittent fever; a disease which at the present time is nearly unknown on the island. In traversing the fever wards of the *Montreal General Hospital*, with Professor Hall, on the 1st of September, 1847, I met, among the cases of continued

\* Lyell's Travels.

† Ibid.

fever, one which seemed to have an intermittent type, but found by inquiry, that the patient had lately sojourned at Oswego, in the State of New York. In examining the summer and autumnal reports of this Hospital, as published in the *British American Journal*, I find the same absence of this form of disease: one or two cases of intermittent—sixty, eighty, or ninety, of continued fever. At Lachine, some of the old inhabitants assured me that they never had intermittent fever, except when it was contracted up the St. Lawrence. Doctor Calder, in three years, had seen no case originating in that village. On the whole, we find that a paludal tract, such as has been described, may, in the latitude of  $45^{\circ} 80'$ , when near the level of the sea, give origin to intermittent fever. The transformation of that tract has nearly annihilated that type of autumnal disease; but remittents, tending strongly to a continued form, still occasionally appear.

#### SECTION IV.

##### REGION SOUTH AND NORTH OF THE ST. LAWRENCE, BETWEEN MONTREAL AND QUEBEC.

I. BASIN OF LAKE CHAMPLAIN.—The long, deep, and narrow trough of Lake Champlain, lies nearly north and south, between the Adirondack Mountains of New York, on the west, and the Green Mountains, of Vermont, on the east. Its head, or southern extremity, is found about latitude  $43^{\circ} 30' N.$ ,—its lower or northern end, a little above  $45^{\circ}$ , where it terminates in the Richelieu or Sorelle River. The course of this river is, also, to the north; which causes it to approach the St. Lawrence very obliquely—the direction of that river, below as above Montreal, being north-east. Their junction is at Fort Henry, below Montreal, a little above the latitude of  $46^{\circ}$ . The elevation of the surface of this lake, the lowest of any considerable size in the eastern or St. Lawrence basin, is ninety-three feet above the ocean, and one hundred and thirty-eight below Lake Ontario. Some portions of the chasm which constitutes its bed, are five hundred feet beneath the level of the sea. Lake George, having an axis nearly parallel to that of Champlain, is connected with its southern portion, and extends the Champlain basin down to the latitude of  $43^{\circ} 25'$ ,\* which is the spot where the Great Interior Valley approaches nearest to the tide-water of the Atlantic Ocean, and where we find the greatest depression of the water-shed which divides them from each other. Throughout the southern half of Lake Champlain, on its western side, the Adirondacks press so close upon it, as greatly to limit its basin. The first considerable river originating on the northern slopes of those mountains, is the Au Sable; the next is the Saranac, which enters the lake at Plattsburg. On the eastern side, beginning near the head of the lake, and traveling down, we meet with Poultney, Otter,

\* New York Geological Reports.



Onion, and Mississiquio, which have their extreme sources on the flanks or among the summits of the Green Mountains of Vermont, where they interlock with tributaries of the Connecticut River. The Champlain basin is much wider on this side than the other. The three principal towns on Lake Champlain are Whitehall and Plattsburgh, in the State of New York, and Burlington, in Vermont. Of their liability to autumnal fever, or of its prevalence on the intervening lake shores, I am uninformed.

II. *VALLEY OF THE RICHELIEU.*—The outlet of Lake Champlain, commencing in latitude  $45^{\circ}$ , terminates in the St. Lawrence, forty-five miles below Montreal, near latitude  $40^{\circ}$ ; thus traversing a degree of latitude, by a course eighty miles in length, and varying a little east of north. The narrow neck of land between Richelieu and the river into which it pours the superfluous waters of Lake Champlain, is mostly a dead level, with a surface rising but a few feet above the St. Lawrence. On the opposite or eastern side, the aspect is much the same. The country on each side is fertile, and has long been settled and cultivated. Something might be said, if I had adequate materials, of a few points: The Isle aux Noix, twelve miles from the lake,—the town of St. Johns, ten miles further down,—that of Chambly a few miles below, and that of Sorelle, at the junction of this river with the St. Lawrence.

*Isle aux Noix.*—This islet is a quarter of a mile wide, and three quarters long. Its surface, composed of vegetable mold and alluvion, rises only four or five feet above the ordinary surface of the river, and much of it, therefore, is liable to inundation, in the spring and in wet seasons. Much of the surrounding country to some distance from the river is low, swampy, and covered with cedar, hemlock, and pine. This island is the site of a British post.\* The Army Statistics do not tell us whether intermittent fever prevails in this locality; but I am informed by Doctor G. W. Douglas, Quarantine Physician, at Gros Isle, and Professor Hall, of Montreal, that it does.

*Chambly.*—I cannot give the medical topography of this spot, but Doctor Kimber, after a residence of twenty-seven years, informs me, that cases of autumnal fever are extremely rare; and that when intermittents do occur, they are in persons who contracted them on the banks of Lake Champlain. He has never seen an intermittent that was generated in Chambly, or its neighborhood. Remittents are met with, now and then, but are almost limited to individuals affected with sub-acute gastritis, or some other chronic ailment, or have been poorly fed and lodged.

III. *THE 'EASTERN TOWNSHIPS.'*—The region directly east of the Richelieu has received this appellation. It is watered by several rivers, all of which, like that just mentioned, flow nearly from south to north,—having their sources at the base, or on the northern escarpments of the Green and White Mountains of Vermont, New Hampshire, and Maine. The most important of these streams, beginning with that contiguous to the Richelieu,

\* Tulloch's Statistical Reports of the British Army.

are the Yamaska, which enters the Lake St. Peter, an expansion of the St. Lawrence; the St. Francis, which originates largely in Lake Memphremagog, and joins the St. Peter below the last; the Nicolet, which enters the same lake, further down; the Becancour, which joins the St. Lawrence still further down; lastly, the Chaudiere, which throws its waters to the level of that river by a remarkable cataract, in the neighborhood of Quebec. Most of this region lies between the latitudes of  $45^{\circ}$  and  $46^{\circ} 30'$  N. and the longitudes of  $70^{\circ}$  and  $73^{\circ}$  W. The surface of this region, generally, if we exclude the mountains which bound it to the south, is composed of a rich mold, resting on loam, with a sub-stratum of gravel, below which are formations of primitive and transition rocks. In its southern part there are a number of small lakes, and along many of the streams there are tracts of alluvial bottom, some of which are prairies. In their descent from the mountain escarpments, the rivers abound in falls and rapids, but as they advance to the St. Lawrence their currents become sluggish, from the prevailing flatness of the country, which, however, is relieved by some insulated mountains.

The whole region was originally covered with various kinds of forest trees; but as a belt near the St. Lawrence was settled by the French, nearly two hundred years since, it now exhibits the aspect of an old country; up some of the rivers, these settlements also extend for some distance, but the greater part of the eastern townships were settled by emigrants from Great Britain at a much later date; and large portions are still covered with forest.\*

IV. HATLEY.—I can say but little of the special medical topography of this region, having only seen it from the St. Lawrence. The town of Hatley, high up the St. Francis River, near Lake Memphremagog, is situate in Lat.  $45^{\circ} 12'$  N. From Doctor Gilbert, one of its physicians, I learn that "Autumnal fevers both intermittent and remittent are unknown within fifty miles of the place, except in persons arriving from the west." I have to regret that no notice of the topography of the region is included in his communication.

V. SHORES OF LAKE ST. PETER.—I am indebted to Doctor Von Iffland, now of Beauport, near Quebec, for the following facts: About ten miles below the mouth of the river Richelieu, on the south side of Lake St. Peter, there is a large tract of low marshy ground, frequently covered by inundations from the St. Lawrence, as well as by floods from heavy rains. There is in the soil abundance of organic matters. About the end of August, almost every year, from 1823 to 1826, when he resided there, remittent fever made its appearance, prevailing more or less, according to the character of the preceding spring and summer. When the spring was dry and the summer hot, so as to evaporate the waters of the ditches and marshes to dryness, the fever became epidemic, and continued until the copious rains of autumn re-filled those receptacles. Nearly all the cases which happened after frost occurred, took on the form of intermittents.

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\* Martin: History of the British Colonies. Vol. III.

About five miles from this locality, to its south-west, there is a stream called Third River, which was choked up with decaying logs and brush, so that in freshets it overspread the adjacent level lands, and generated marshes. About the year 1823, five or six families settled in log cabins near the river at this spot, and began clearing the forest. In the first autumn every member of all the families sickened with intermittent fever; but after the lapse of three years, when the necessary transformations were effected, the disease ceased so entirely that Doctor Von Island thinks no case has occurred since 1826. The latitude of this spot is  $46^{\circ}$  N.—its altitude but a few feet above the level of the sea.

VI. THE TOWNSHIPS GENERALLY.—Doctor Douglas, of Gros Isle, writes to me as follows:—"I have been informed by the old settlers in the eastern townships, that thirty years since (1818) intermittent fever was a common disease in the neighborhood of lakes and low grounds, though now it is unknown."

I have given all the facts I have been able to collect, relative to autumnal fever, on the south-east side of that portion of the St. Lawrence, which extends from Montreal to Quebec, and from the forty-fifth to near the forty-seventh parallel of latitude, at an elevation but little above the tide-water in the river. The conclusion from the whole seems to be, that in the progress of settlement, clearing, and first cultivation, both intermittents and remittents prevailed, but have ceased; although topographical causes remain which would generate them, even to an epidemic degree, in a more southern climate. We must now pass to the north side of the river.

VII. NORTH SIDE OF THE ST. LAWRENCE.—The immediate bank of the river on its left-hand side, from Montreal until we come within twelve or fifteen miles of Quebec, like that of the right-hand side, is so depressed as to be but a few feet above the surface of the river. The low and level region on this side is, however, much more limited than on the other. By terrace-like rises it becomes elevated into mountains, at the distance of thirty or forty miles. Of this region, Doctor Gilmour, of the town of Three Rivers, remarks,—“This part of Lower Canada is generally sandy; some districts are well watered by beautiful rivers; the inhabitants very poor, but healthy and long-lived. Intermittent and remittent fevers are scarcely known; I have never seen any but imported cases, or such as had suffered from previous attacks contracted out of the lower province.” The region within which these observations were made stretches obliquely from the forty-sixth to the forty-seventh parallel, and, near the St. Lawrence, rises but a few feet above the level of the sea.

The largest river which traverses this region is the St. Maurice, whose *embouchure* is formed into a delta, by two small islands which divide it into three channels, immediately above which is the old French town *Trois Rivières*, now the ‘Three Rivers’ just mentioned. Its latitude is about  $46^{\circ} 22'$  N.—its position equi-distant between Montreal and Quebec.

VIII. THE RIVER FROM MONTREAL TO QUEBEC.—The succession of rapids which begins near Prescott and Ogdensburg, terminates at or a little



below Montreal. From that city to the head of tide-water, at the Three Rivers—mouth of the St. Maurice—the fall is only eighteen feet, much of which is in the expiring rapids below the city. Then follows a level, more than one hundred and fifty miles long, with banks rising but little above the surface of the water. This flat extends off from both sides of the river; but, as we have seen, much further on the southern than on the northern. In this stretch of the river we have the expansion—ten miles wide and twenty miles long—called Lake St. Peter. As we approach Quebec, the highlands come in upon the river, which narrows, and no longer exhibits alluvial shores. Such are some of the facts which have suggested the opinion, that the region between the two cities was once a lake, and that the existing Lake St. Peter is all that remains of it. The low banks of this section of the St. Lawrence seem to have been at all times the favorite abode of the French, who still constitute the mass of their population.

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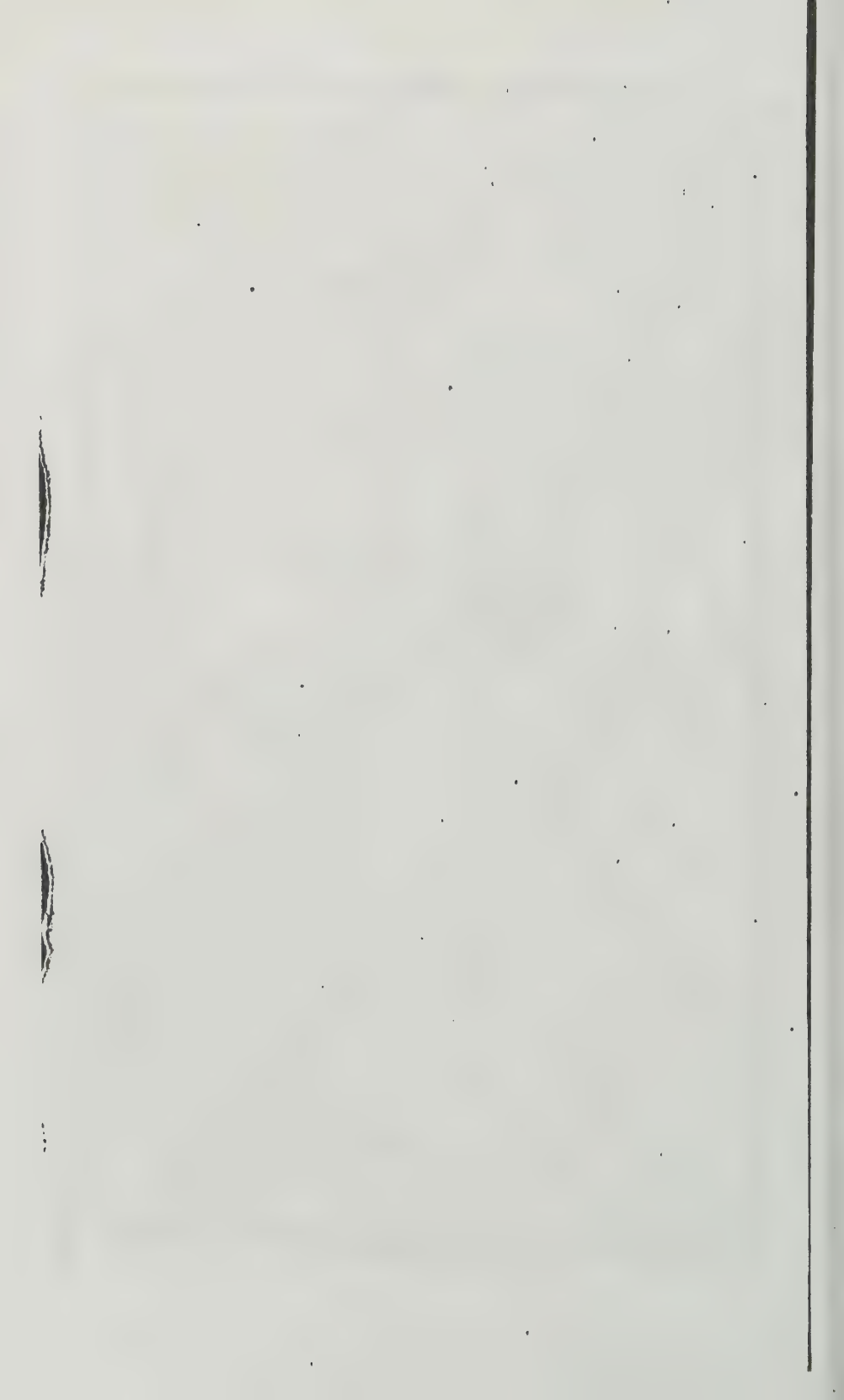
## SECTION V.

### QUEBEC.

I. The approach to this celebrated city (*Pl. XVII*), the oldest in the Interior Valley of North America, is signalized by rocky and rising banks, of which that on the left or northern side becomes almost perpendicular, and, at length, terminates in a bold promontory of old Silurian or transition rocks, rising from three hundred and thirty to three hundred and forty-five feet above the tide-water, which ebbs and flows at its base. This termination is effected by the junction with the St. Lawrence of the River St. Charles; which bears a relation to the northern side of the head-land not unlike that of the greater river to its southern. The high extremity which overlooks the St. Lawrence is called Cape Diamond, and supports the citadel of the fortress,—for Quebec is a fortified city. From these heights, there is a gentle escarpment, up the promontory, to the plains of Abraham, and across it to the estuary of the St. Charles; the final descent into which, however, is by a rocky precipice, to which the ramparts of the fortification conform. The plateau stretches westwardly between the two rivers, to the distance of eight or nine miles, when it is interrupted by a deep and broad depression, one end of which terminates in the trough of the St. Lawrence—the other, in that of the St. Charles. In ancient times there was, no doubt, a flow of water through this depression, from one river to the other, making an island of what is now a promontory.

For four or five miles up the St. Lawrence from Cape Diamond, the river approaches so near the base of the precipice, that there is only room for a single narrow street or road, which, for a portion of the distance, is compactly built along—in some parts on one, in others on both sides. In the rear of these crowded habitations, are the Cliffs, from two to three hundred







feet high, immediately in front of which, the river covers are overspread with rafts of timber, the great commercial staple of Quebec.

As this slip of habitable shore passes round Cape Diamond, it widens; and, at length, admits of another street, to which a third is added, before it reaches the junction of the St. Charles with the St. Lawrence. The squares, however, are very small; and the streets in general barely wide enough to permit carriages to pass each other. This is the Lower Town, which has the aspect and reality of a close and grotesque huddle of business and family houses, which the most searching winds must fail to purify, and the filth from which is cast into the river among the adjoining wharves. On turning the head-land, and entering the valley of the St. Charles, the belt widens into an alluvial bottom, in which there are many small squares, with wider streets, a better style of architecture, and less density of population.

The Upper Town stands on the northern or St. Charles slope of the promontory, partly within and partly without the walls of the fortification. Portions of it have sufficient width of street, and houses in modern taste; but the older parts are amorphous, compact, and strangled. The St. Charles is an alluvial river, tortuous near the city, and expanding into an estuary; portions of which are daily laid bare by the ebbing of the tide. Beyond it, there are cultivated diluvial terraces. The opposite, or southern bank of the St. Lawrence, presents hills of considerable elevation. Immediately below the junction of the St. Charles, the river expands into a basin, which constitutes the harbor, into the south side of which point Levy projects, and on which there is a town.

For one hundred and sixty years after its settlement by France, Quebec received but few immigrants from any other nation. In 1708 it passed into the hands of Great Britain. The emigration from France was then succeeded by that from England, Scotland, and Ireland, which has continued ever since. A considerable military force has always been quartered in the city, and a large number of seamen are generally in its port. The population of the city and its suburbs amounted in 1844 to 82,870—that of the county of Quebec, to 45,670, composed of the following classes:

Natives of England,	-	-	-	1,598
" Ireland,	-	-	-	7,207
" Scotland,	-	-	-	981
" Canada, of French origin,	-	-	-	27,098
" " of British origin,	-	-	-	7,784
" Continent of Europe, or otherwise,	-	-	-	276
" United States,	-	-	-	122
				—45,070*

This table does not, however, give the proportions in the city, for the relative number of Canadian French in the country is greater than in town.

II. Such is the medical topography of Quebec; and it presents two localities well-fitted to generate autumnal fever;—the covers of the St. Lawrence,

with their macerating logs, and the estuary of the St. Charles. That fever, however, seems to be here unknown, as an original disease. Dr. Parant, one of the oldest and most observing of the French physicians, assured me that he had seen no case not contracted up the St. Lawrence. Dr. Morrin, after an experience of nearly thirty years, affirmed that autumnal fever, as an indigenous disease, was absolutely unknown; and added, that those who came with intermittent fever from the country above, got well spontaneously. The late Dr. Racy, from a shorter course of observation, testified in the same terms. Dr. J. Douglas concurred in these statements, and added, that he had repeatedly seen persons attacked with intermittent fever, several months and even a year after they had visited localities in the south-west, where it was prevailing. Finally, the hospital reports, for 1820 and '27, as published in Tessier's "*Quebec Medical Journal*," confirm the statements of these gentlemen.

In referring to the causes of this exemption, we must not forget that Quebec was settled in 1603 or '4, and that autumnal fever is, especially, a disease of newly peopled countries. When it disappears, however, it is because the topographical conditions on which it depends are removed. But although much of the country surrounding Quebec has long been cultivated, an entire abatement of those conditions has not taken place; for the cooves of the St. Lawrence could never have been in a worse condition than at present; and the estuary of the St. Charles is still in a state to favor the production of that fever. We may conclude, then, that the absence from Quebec of the fever, is, in part, attributable to its latitude,  $46^{\circ} 47' 30''$  north. The same, however, cannot be said of remittent fever, cases of which now and then occur, but invariably tend to a continued type.

## SECTION VI.

### ESTUARY OF THE ST. LAWRENCE.

I. Taking the head of tide-water as the beginning of the estuary, it starts from the town of Three Rivers, at the mouth of the St. Maurice, eighty-four miles above Quebec. From that point to the island of Anticosti, where the river St. Lawrence opens by two broad mouths into the Gulf of St. Lawrence, the distance is about four hundred and fifty miles. That island lies in the northern part of the Gulf. The latitude of its western end is  $49^{\circ} 52' 29''$  N., its longitude  $64^{\circ} 36' 54''$  W.\* Thus its latitude is nearly the same with the sources of the Missouri river, which lie in longitude  $112^{\circ}$  W., making the breadth of the valley forty-eight degrees of longitude, or about two thousand two hundred miles on a straight line.

It deserves to be noted, as illustrating the natural mechanism of the great intermontane valley, that an air-line from the island of Anticosti over the St.

\* Martin's Hist. Brit. Col.

Lawrence, Lake Ontario, and Lake Erie, strikes the Mississippi at the mouth of the Missouri river, without attaining a greater land-elevation than seven or eight hundred feet; and, consequently, it follows, that one hundred miles above Fort Leavenworth, the Missouri river has sufficient elevation to pour its waters into the Gulf of St. Lawrence, instead of the Gulf of Mexico, thirty degrees further south. But we must return to the estuary.

Immediately below Quebec the river divides, and, by re-uniting, forms the beautiful and long-cultivated Island of Orleans; the northern side of which has marshy shores, but they are not ungrain. Below this island, the river never contracts to its former limits, but gradually widens to the gulf. At Gros Isle, the quarantine station for the port of Quebec, thirty-two miles below the city, the water has a brackish taste, which, of course, increases as we descend; and unites with the increasing width and depth, in giving to the estuary the character of a bay, or deeply penetrating arm of the sea.

The popular belief that the Appalachian Mountains terminate when they reach the St. Lawrence below Quebec, is erroneous. They are only interrupted, and re-appear on its northern side. Thus the estuary of the river lies in a broad chasm of the mountain chain, the bottom of which, like that of the great lakes, is far below the level of the sea; and, from the interior of the State of Alabama, to the inhospitable regions of Labrador, through twenty degrees of latitude, this is the only gap in the mountain chain, which sinks to the surface of the Atlantic Ocean.

II. On the south side of the estuary, the high lands approach more or less closely to the river, as far down as Cape Gaspé, at the Gulf of St. Lawrence, where they terminate. Opposite Quebec, they reach the river, but not as mountains; further down they recede, and leave a belt of settled and cultivated interval-land, in the county of Val-de-la-Petite; to which several other belts, generally narrower, succeed; but the proportion of inhabitants, who are chiefly French, gets less and less as we descend. From the close proximity of the mountains, the rivers on this side of the St. Lawrence are all short, none equaling the Chaudière and other tributaries of the great river, between Quebec and Montreal.

I learn from Dr. Marmotto, who has resided nine years in the county of St. Thomas, thirty-three miles below Quebec, and practiced his profession also in the parishes of Northia and St. Pierre, that the length of coast with which he is familiar, is about eighteen or twenty miles, with a breadth of from one to eight. Near the river, in many places, the surface is flat, but it rises in the manner of an amphitheater, to the high hills or mountains, which are at the distance of a few miles, and at which the settlements terminate. The elevation is from twenty-five to two hundred feet above the level of the tide-water of the St. Lawrence; but there are in the belt a number of hills, either wooded or cultivated. Two small rivers, having numerous tributaries, water the belt, which embraces but few marshes, and they are of limited extent. Several considerable tracts, however, are subject to inundation in the month of April; but the water is always pure, and flows off before the onset of summer, leaving a cultivable surface, some



parts of which, converted into meadows, have been ditched. The people of this district are chiefly employed in agriculture, and in getting out timber and stone for exportation. Dr. Marmetto has never seen a case of intermittent fever that originated in the district, and does not believe that it is ever produced below Quebec.

Dr. Michaud, who has long resided further down the coast, at St. Louis de Kamouraska, about latitude  $47^{\circ} 31'$  north, informs me that within the basin and near the banks of the little river Ouelle, which traverses the belt between the mountains and the estuary of the St. Lawrence, there is a wet savanna or marsh, about five miles long and three broad, which abounds in vegetable matters in a state of decay. The belt presents many diluvial terraces. The population is chiefly agricultural. Of fourteen thousand and sixty-seven cases of disease, treated by him, but three were intermittent fever. Two of these patients had contracted the disease at a previous period in the United States, and the third had sojourned in a paludal situation in the States, ten years before he was seized with the disease in Kamouraska. In the conclusion of his letter, Dr. Michaud makes the following statement, which he believes to be true: "Neither intermittent nor remittent fever has ever originated in the vicinity of marshes situated between the forty-seventh and forty-ninth degrees of latitude, that is, from Quebec to the Gulf of St. Lawrence."

It would seem, from the united testimony of the two gentlemen who have been quoted, that we have here, at the level of the sea, passed beyond the geographical limits of autumnal fever.

III. The valley-land on the other or northern side of the estuary is still narrower, and the cultivation more limited.

The first river below Quebec, is the *Montmorenci*, of no great length or volume, but remarkable for its falls, eight miles below the city. The next and by far the largest which enters the estuary is the

*Saguenay*.—It joins the St. Lawrence, one hundred and forty miles below Quebec, and at its mouth has been sounded to the depth of two thousand feet, without finding bottom; two miles up, its depth is eight hundred feet, and at the distance of nearly fifty miles, the sounding lead descends to the depth of three hundred feet.

The rocky hills rise with exceeding steepness, on both sides of this river, to the height of twelve or fifteen hundred feet. At length we reach the place where this river descends into this deep rocky chasm, by a series of rapids from Lake St. John, though its true and more distant sources are the water-shed between the St. Lawrence and Hudson Bay.\* Rugged as are the shores of the Saguenay, they are not without inhabitants, who might present to the medical inquirer, opportunities for ascertaining the character of autumnal diseases, in the latitude of  $48^{\circ}$ , at the level of the sea, though remote from its shores; but I have not been able to acquire the requisite information.

\* Rep. of Com. for exploring the Saguenay, 1829.

Below the Saguenay there are other but lesser rivers, near the mouths of which, and around many small bays of the estuary, there are feeble settlements, concerning which nothing can at present be said, of interest to the ethiologist.

IV. THE GULF OF ST. LAWRENCE must receive a passing notice to complete our survey of this basin. As but one great river enters the Gulf of Mexico, so but one enters the Gulf of St. Lawrence; and these great rivers have their waters interlocked, from the sources of the Alleghany and Genesee, round to those of the Mississippi, and St. Louis of Lake Superior, a distance of more than one thousand miles. To the south-east, the Gulf of St. Lawrence opens into the Atlantic Ocean, by a broad strait; to the north-east, into Davis Strait, by a narrower, called Belle Isle. Labrador lies to its north, New Brunswick and Nova Scotia to its south-west and south, Breton Island to its south-east, and the great Island of Newfoundland to its east. Around this island, in front of the Gulf, lie the famous sub-marine shoals of Newfoundland, a moment's reference to which, I hope may be pardoned. If the reader will turn to the hydrographical map [Pl. I], he will see, that the course of the Lakes and the St. Lawrence, from the sources of the rivers which enter the western end of Lake Erie, is nearly north-east. If he will then carry his eye on the same meridian, to Cape Florida and the Havana, he will perceive the origin of the Gulf Stream, and tracing it by the arrows, will find that its general course is to the banks of Newfoundland, and that the marine and continental rivers flow nearly parallel, yet slightly converged, being separated by the Appalachian mountains, and the plains connected with them. Still further, it has been shown, when treating of the Gulf of Mexico, that a part of the waters of the Mississippi are carried through the straits of Florida, and make a portion of the Gulf Stream. Thus different parts of a shower, falling near the center of the continent, notwithstanding they take nearly opposite directions, at last mingle over the banks of Newfoundland, carrying with them more or less of the surface, either in solution or suspension. Finally, if the reader will glance his eye upon Davis Strait he will perceive by the course of the arrows, that a current, which brings down icebergs from Baffin's Bay, sets, also, upon the banks of Newfoundland, and must transport thither more or less of the debris of the arctic regions of the continent. Thus, one terrestrial and two marine currents, meet over those sub-marine beds, and contribute to 'build them up from the depths of the ocean; while the organic matter, thus transported, attracts such shoals of fishes, as to render this spot the fishery of the world. Such is the magnificent system of hydrology, in which our great Interior Valley plays an important part.

## SECTION VII.

## PARALLEL BETWEEN THE MISSISSIPPI AND ST. LAWRENCE RIVERS.

I. The Mississippi flows nearly from north to south; the St. Lawrence, originating in the same region, flows to the south-east, and then to the north-east, being turned by the flanks of the Appalachian Mountains. The sources and *embouchure* of the former are in the same meridians—of the latter in the same parallels: One is a river of latitudes, the other of longitudes. It results from these dissimilitudes—*First*, That the banks of the Mississippi will forever present diversities of organic life, both vegetable and animal, far exceeding the varieties offered by those of the St. Lawrence; *Second*, That the diversities of disease along the former will always be more numerous and striking, than along the latter.

II. While the multiplied sources, primary and collateral, of the two rivers are found at nearly the same elevation above the sea, those of the Mississippi reach it by much longer routes than those of the St. Lawrence; and, descending by regularly inclined planes, present, in their course, but few lacustrine pools and cascades. On the other hand, the St. Lawrence is characterized, almost through its whole length, by reservoirs or lakes, rapids and cataracts, exceeding in number, beauty and sublimity, those of any other river of the continent.

III. The quantity of water discharged, annually, by the Mississippi, is much less, in proportion to the area of its basin, than that discharged by the St. Lawrence; which results from the following causes: *First*, But little rain, comparatively, falls on the western portions of the Mississippi basin; *Second*, The deeper deposits of loose, diluvial materials, which bury up its rocky strata, permit more to sink into the earth; *Third*, Greater quantities escape upon the low and broad alluvial plains which border its rivers, than upon those of the St. Lawrence, much of which does not flow back, but is either evaporated or absorbed; *Fourth*, The higher heat of the climate through which the Mississippi flows, for half its entire course, favors greater evaporation than can take place from the St. Lawrence. This evaporation, on the lower Mississippi and the southern tributaries, continues in activity throughout the year, but in the basin of the St. Lawrence, it is almost suspended for one-third of that period.

IV. The amount of drift-wood and softer vegetable matter, borne down to the sea, or lodged along its banks, by the Mississippi, is incomparably greater than that of the St. Lawrence; which results from the looser alluvial bottoms, higher freshets, and more regular descent of that river and its tributaries; and hence it follows, that while the former is thus making deposits in the sea, to be converted into coal, for the benefit of future ages, the latter will be found unfruitful in such benefactions.

V. A still greater difference exists between these rivers, in the quantity of earthy matter which they transport to the sea. Many of the larger tributaries of the Mississippi, and that river itself, for its lower fourteen hun-



dred miles, are always turbid; but the St. Lawrence, on the other hand, is always transparent; and most of its affluents, even when swollen, have less muddiness than those of the Mississippi. This depends on two causes, — one geological, the other mechanical: *First*, The proportion of sandy and argillaceous drift or diluvium, overspreading the basin of the Mississippi, is greater than that of the St. Lawrence basin; and it embraces extensive friable deposits, tertiary and cretaceous; *Second*, It abounds in soft shales and marls. On the other hand: *First*, The basin of the St. Lawrence presents a great predominance of hard primitive and transition, or old Silurian rocks, which undergo disintegration very slowly; *Second*, The lakes into which the streams of that basin first pour their muddy waters, become the depositories of their silt, and decant clarified waters into the St. Lawrence. It has resulted from this, that while the Mississippi has filled up the bay, or arm of the gulf, which once projected far into the continent, and is now constructing a cape in the Gulf of Mexico, the St. Lawrence has made but little progress in that labor, and is still met by the tides nearly five hundred miles from its gulf.

VI. In regard to the transportation of ice to the sea, the two rivers differ still more widely. The Mississippi carries none whatever, and is never frozen over, through the lower eight hundred miles of its course: the St. Lawrence, however, freezes every winter, and, below Lake Ontario, is obstructed with ice for one-third of the year. This ice destroys the equability of climate along the St. Lawrence. The breaking up begins in Lake Erie and the Niagara river, then in Lake Ontario, and, progressively, in the river below. By the rapid current in the Niagara and the St. Lawrence, the ice is carried down to the estuary, where it lodges, to a late period in spring, giving to its banks, at and beyond Quebec, a much tardier opening of vegetation, compared with that of the Island of Montreal, than would result from the difference of latitude. On the lower part of the Mississippi, where this disturbing influence does not exist, the increment and decrement of heat are left to the joint influence of latitude and elevation. The annual range of the temperature of the two rivers, in their lower sections, is not the same. In summer and autumn, the Mississippi and its tributaries, greatly reduced in volume, have the heat of their waters very much raised; but the quantity of water in the St. Lawrence varies but little, and is nearly all derived from deep lakes; hence its summer, compared with its winter heat, is much less than that of the Mississippi; thus reversing, as we shall hereafter see, the law of mean atmospheric winter and summer temperature.

VII. In their scenery, the lower portions of these great rivers differ as widely as in other characteristics. On the Mississippi, from Memphis to Baton Rouge, the voyager sees bluffs to his left hand, which gradually get lower and lower, until they disappear; and he finds himself in the midst of a swampy plain, which all along had met his eye, to the right. For two hundred and fifty miles he looks down upon this new creation of the waters, of which the highest ridges are the dykes which confine the river to its proper bed. They at length cease, and before his boat floats on the gulf,

he sees the agitation which it raises, drive the turbid waters of the river, over its low and sedgy banks, to mingle with the green tides of the sea. On the St. Lawrence, from Montreal to Quebec, there are also low banks, but higher lands in their rear, and blue mountain masses in the distance; which, as the voyager advances, approach the river, and embrace it more or less closely, to the Gulf of St. Lawrence. The birches, maples, and larches, here represent the cotton-tree, liquid-amber, live oak, and cypress, with its dark silvery tresses of long moss; orchards of plums and apples, are substituted for the peach, fig, and orange tree; and fields of wheat, oats, peas, timothy, and potatoes, take the place of cotton, sugar, and rice plantations.

VIII. By a single aspect, only, is the traveler on the Lower St. Lawrence, reminded of the Lower Mississippi. The depressed banks between Montreal and Quebec, like those through the ancient Delta of the Mississippi, above and below New Orleans, are the favorite abodes of the French. The '*habitant*' and the '*creole*,' under the same national instinct, have placed their cottages in village-ranks, on the banks of their respective rivers, and cultivated long narrow parallelograms in their rear; but the verandas, climbing roses, camillas, and pomegranates, which decorate these humble dwellings in the south, are wanting on the rigorous shores of the north; and by their absence, chiefly, is the voyager preserved from the delusion, that he is not within the Delta of the Mississippi, when his boat is rapidly moving on this portion of the St. Lawrence.

IX. If these two rivers, with their respective geological accompaniments, had been placed respectively, in each other's geographical position, their medical histories would have been widely different from what they now are. The alluvial deposits of the Mississippi would, it is true, have carried autumnal fever, somewhat further north than we now find it; but the greatest difference from the present state of health, would have been found in the south, where a mountain range, and the almost total absence of deposits of silt and organic matter, would have nearly precluded those fevers, which the burning sun of summer and autumn now quicken into annual prevalence.

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## SECTION VIII.

### OF THE ST. LAWRENCE, AS A PLACE OF SUMMER RESORT FOR INVALIDS.

When the invalid, in quest of a cooler and purer summer air, in connection with exercise and recreation, arrives on the southern shores of Lake Erie, he may turn either to the north-west or north-east. In the former case, he will make the voyage upon the Upper Lakes, which has been already described; in the latter, he will visit the Niagara and St. Lawrence, with the lower lakes, Ontario and Champlain.

As the Falls of Niagara fill every imagination, it is unnecessary to speak of their solemn, monotonous, and unequalled sublimity, which does not

long sustain the deep emotion which they at first inspire. It will be more profitable to point out to the inquiring and contemplative invalid certain objects, the examination of which cannot fail to interest and excite him. *First*, By a careful inspection of the rocks, he will discover the mode in which they are cut through, and the recession of the Falls has been effected. *Second*, By tracing the gravel banks which are found on both sides of the deep ravine, he will perceive, that a broad surface-stream (such as the river now is above the rapids) once flowed where the chasm has since been excavated. *Third*, He should visit the whirlpool on the Canada side, and trace the channel, now filled with drift and rubbish, by which the river, or a part of it, formerly reached Lake Ontario, near St. David's, several miles west of the present outlet.\* *Fourth*, He should then ascend the heights of Queenston, which, though less amazing to his senses, will be found more suggestive to his mind, than the Falls themselves. By his side, the lower end of the dark and winding chasm, with the leaden-green waters, in deep but silent agitation, as they escape from their rocky imprisonment; before him, broad sloping terraces, down which they are quickly gliding to the bosom of Lake Ontario; on every side, the signs that the waves of the lake once dashed against the cliffs, from which he now sees them, at the distance of many miles, and that the Niagara, at some remote period, threw down its torrents from the very summit on which he is meditating. Thus planted, as it were, at the beginning, in both time and place, of two mighty events — the retreat of the Lake and the recession of the Falls — he will soon feel that the pleasures of sense are superficial and fleeting, compared with the deep and bewildering emotions, which arise from a contemplation of the powers by which changes so mighty have been brought forth. But a sojourn of an hour will not raise these discursive and lofty meditations. He should linger for a day, cross the river, look up the black gorge from which it is issuing, ascend the heights of Lewiston, and then descend, and wander among the vast fragments of fallen rock, which in ages long passed, were polished by the dashing waters of the Lake. Thus will his mind be roused into action, and come at length to apprehend the magnitude of the problems which nature here presents for solution.

When the invalid has embarked on Lake Ontario, he should descend by its northern coast, and spend a day, or more, at Hamilton, Toronto, and Kingston; where, in the absence of natural scenery of a striking character, he will find novelties in art and society, which will stimulate his senses and mind, in a different way from the wild grandeur of Niagara; and thus, by a new agency, extend the salutary impression there made.

At Kingston he will reëmbark for the St. Lawrence, and his first stopping-place should be Ogdensburg, on the American side. The voyage will be through the Thousand Islands. The elements of this landscape are a broad plain, overspread with water, sending up through its surface masses and groups of granito, and other primitive rocks, bare and weathered on their



low summits, or lightly covered with soil, supporting stunted pines, oaks, and maples. He has now exchanged the sublimities of Niagara for the beauties of the St. Lawrence, and a corresponding change will take place in his emotions. Among the Islands, and below, to Ogdensburg, the current of the river is slow and unruffled. A few miles further down, the first rapids begin, and thence to the Island of Montreal the mingled grandeur and beauty of the voyage raise it above any other of equal length, in the travelled portions of the continent. Everywhere the banks have an aspect of stability, and govern the river, not existing at its mercy like those of the Mississippi. Now they approach, and now they are widely separated by an island; here is a stretch of gentle current, and there a frightful cascade, in which the light-green and limpid waters are dashed into white foam, as they rush furiously down the rocky slope, to repose in some broad basin, with grassy margins, and prepare themselves, as it were, for a new descent. Finally, the blue summits of the mountains which overshadow Lake Champlain, and afterward those of Canada East, begin to peer above the horizon, and by the solemn quietness of their aspect, mingle a new emotion with those which the river had awakened.

A day on the Island of Montreal, is the fashionable allotment; but a week will not exhaust the sources of interest to an inquiring invalid; who can there command every comfort, while he substitutes the novelties of its social condition for those of natural scenery, in a higher latitude than he can reach in the valley of the Mississippi.

The voyage to Quebec will bring only repose of feeling. He is now on tide-water; the rapids are at an end, the river widens, and at length expands into the beautiful Lake St. Peter, then contracts: its course is straight, its banks so low, as barely to rise above the high tides, and so thickly overspread with the cottages of the '*Habitants*,' and the more ambitious dwellings of the '*Seigneurs*, that, but for the perfect transparency of the waters they inclose, he might fancy himself on the Lower Mississippi.

A week at Quebec will not exhaust the curiosities of nature and art in which it abounds, nor bring into existence all the historical recollections which it can awaken. Cape Diamond and its citadel—streets with dwellings on one side, and batteries bristling with cannon on the other—embrasures and windows in juxta-position—long ranges of steps from the Lower to the Upper town—gates guarded by sentinels—soldiers, sailors, and citizens, mingled on the same narrow pavement—dogs as well as ponies in harness, and drawing their little wagons through the streets—French and English signs in alternation, on the doors, and the dialects of the two nations, blended within. Thus the foreign invalid, or hypochondriac, may absorb something through every pore, to change the condition of his nervous system. But, escaping from the city, he may drive over the elevated plains of Abraham; then, at the distance of nine miles, visit Loretto, and see a remnant of the oldest civilized Indians of the continent; then, at an equal distance, devote a day to the celebrated Falls of Montmorenci; and, on

another, feast his eyes on those of the river Chaudiere, with its wild, romantic scenery.

Quebec is the *ultima thule* of those who make hasty voyages, for idle amusement, or from mere restlessness; but as I am writing for the benefit of invalids, who need the invigorating influence of a cool summer climate, in connection with exercise and new scenes and objects, I shall add, that the voyage, when practicable, should be continued beyond Quebec, to the *Riviere de Loup*, at the distance of one hundred and twenty miles, or even to the Saguenay, thirty miles further down. The great breadth of the estuary, now become a bay, the mountain scenery on both sides, and the coolness of the climate, in a higher latitude than the utmost sources of the Mississippi, would greatly add to the benefits which a southern valetudinary might promise himself from travels in the north.

Returning to Montreal, he should not ascend the St. Lawrence any higher, but cross by rail-road to Lake Champlain, whose grand and picturesque scenery may still interest him, if he have not become cloyed by the natural wonders of the Niagara and St. Lawrence. At the end of this voyage, he may rest at Saratoga, and, then, either descend the Atlantic plain, and visit the cities of the sea-board; or, turning to the west, make his first stopping-place at Syracuse, where the extensive salines will present a new object of interest. From that town he may make a short canal voyage through the beautiful Oswego Valley, which presents several objects of interest, to the town of that name, and there embark for Rochester; or he may continue from Syracuse, by land, and visit the beautiful serpentine lakes of western New York, reaching the city of Rochester by rail-road. Having gratified his curiosity, by the various views which may be had of the Falls by which the Genesee River descends nearly three hundred feet in three miles, he may either proceed to Buffalo, by Niagara, or ascend the Genesee River, and visiting its upper and still grander cascades, traverse the mountain plain to Chautauque Lake, and thence descend to Dunkirk, on the southern shore of Lake Erie.

*Conclusion.*—The topography of the St. Lawrence or Eastern basin is now closed, but not completed. If, in its progress and at its end, some pages have been devoted to places of hot-weather residence, or routes of summer travel, for the victims of our southern climates, or the invalids of our numerous cities, my brethren, on reflection, will, I trust, approve rather than condemn the object. Nearly all the settled portions of the southern or Mexican basin are comparatively flat and uniform, without lakes or mountains, and deficient in running streams and water-falls. The basin of the St. Lawrence is its *north*, and opens to its invalids, in hot weather, a retreat which they cannot have in any other direction; for the southern portions of the Appalachian Mountains are too inaccessible, and the Rocky Mountains too remote. It is not sufficient for the physician to advise his patient, laboring under a chronic infirmity, to leave off medicine and depend on travel. When he prescribes the former, he directs where it can be obtained; and, in like manner, when he recommends the latter, he

should be able to lay down the appropriate and practicable route; in doing which, he should draw his information from the books of his profession, and convince his patient that he is familiar with what he recommends, or but little confidence will be reposed in his advice.

## CHAPTER XVI.

### THE HUDSON AND ARCTIC HYDROGRAPHICAL BASINS.

#### INTRODUCTION.

THE Mexican and St. Lawrence Hydrographical Basins, include nearly all the white or Caucasian population of the Interior Valley of North America; but its medical topography would be incomplete, and imperfect, even in reference to the diseases of those basins, if some general geographical and hydrographical views were not taken of the more desolate and unpeopled regions which lie to their north, and are quite equal in area to those which have been described. The Hudson Basin, moreover, at one point of its southern border—the sources of Red River—dips into the Mexican as low as the latitude of  $45^{\circ} 30'$ ; thus bringing a part of the northern basins within the limits of prospective settlement and cultivation. The value of a study of the physical geography and meteorology of the northern regions may be concisely presented under the following heads:

I. It is an admitted fact, that if the Rocky Mountains, and other Alpine ranges, which lie to the west of the Mexican and St. Lawrence Basins, did not exist, but the great plain which they now subdivide stretched out to the Pacific Ocean, our climates would be entirely different from what they now are; and hence it follows, that he who would understand the latter, must be aware of the existence of the former. If this be true,—and it cannot be denied—it is obvious that the meteorologist should know whether the northern regions are a flat, or overspread with mountain chains.

II. In tracing out the combined and separate influence of soil and climate on our diseases, it is necessary to examine them to the very limits of the continent, in the north, or until they cease from climatic changes.

III. The Northern Basins embrace many tribes of Indians, whose physiology and diseases are to become subjects of study, in the closing part of our work.



IV. In the extreme north there are permanent settlements of Esquimaux, a different race from the Indians, the study of whose constitutions and maladies, under the remarkable circumstances in which they live, cannot be without interest.

V. Both the Hudson and Arctic Basins have been explored by so many Europeans and Americans, that many valuable observations have been made, on the effects of long-continued, intense cold, on the constitutions of the Caucasian races, thus represented in those frigid and dreary regions; all of which stand in curious and striking contrast with the effects of the high and prolonged heat of the tropical regions around the Gulf of Mexico.

A topography of the north is not necessary, however, to the developments here indicated; and I shall limit myself to such comprehensive geographical and hydrographical views, as may be condensed into a single chapter, beginning with the Hudson Basin, which lies immediately north of the two which have been described.\*

## SECTION I.

### THE HUDSON HYDROGRAPHICAL BASIN.

I. THE BAY. — A large portion of this basin is overspread with the inland sea, absurdly called *Hudson's Bay*, which lies a little to the north-east of its center. In figure it resembles the transverse vertical section of a mountain. Its base lies nearly in the seventy-ninth meridian, while its apex reaches to the ninety-fifth. The sixtieth parallel of north latitude passes through its center. Its southern extremity, called James' Bay, sinks to the fifty-first degree of latitude, and the opposite rises to the arctic circle. Its area is nearly the same with that of the Gulf of Mexico, from which, however, must be deducted the large Island of Southampton, lying in its northern part, in mean latitude  $63^{\circ}$ , opposite the entrance of Hudson's Straits, which connect the bay with Davis' Straits and the Atlantic Ocean. The surface of this bay is so obstructed with ice, as to render its navigation impracticable eight months out of every twelve. Even in July and August, Parry and Franklin found the straits which lead to it embarrassed with icebergs; and in its northern regions, great fields of floating ice frequently

\* For the principal facts of this chapter, I am indebted to the following works, to which I shall seldom refer specially in the text, after having cited them here: — HEARN'S *Overland Journey to the Polar Sea*, 1769—1772. MACKENZIE'S *Voyage down McKenzie's River to the same sea*, 1789. PARRY'S *First Voyage through Baffin's Bay*, 1819—1820. His *Second*, 1822—1823. His *Third*, 1822—1825. FRANKLIN'S *First Overland Journey from Hudson's Bay to the Polar Sea*, 1820—1823. His *Second from Lake Superior to the same sea*, 1822—1823. RICHARDSON'S *Narrative of his Travels with Franklin*, and several of his papers on the geology, zoology, botany, climate and inhabitants of the arctic regions of America. LONA'S *Second Expedition, to Lake Winnipeg*, 1823. ROSS'S *Second Voyage through Baffin's Bay*, 1820—1833. BACK'S *Arctic Land Expedition*, 1833—1835.

inclosed the ships of the former, as they had previously done those of other navigators. During winter, this ice is everywhere accumulated on its inhospitable shores, which, even on its southern side, remain frozen to rocky hardness, throughout the longest summers, at the depth of three or four feet below the surface. In some parts the coasts are bold and rocky; in others, low and swampy, like those of the Gulf of Mexico;—and this, according to Doctor Richardson, is especially true of those which lie farthest south.

Although Hudson's Bay was discovered by the intrepid but unfortunate English navigator whose name it bears, as early as 1610, its desolate shores have but few civilized inhabitants, except the officers, voyageurs, and trappers of the United Hudson's Bay and North West Fur Companies. They reside or congregate at a few factories, chiefly near the mouths of rivers, on the southern coast, from the mouth of Nelson's River to the head of James' Bay, where there are some limited settlements of a more permanent kind. This failure in the colonization of the shores of a sea, which correspond in latitude with those of the Baltic, where we find the large cities of Stockholm, Copenhagen, and St. Petersburg, will cease to excite surprise, when we reflect on the physical condition which has been described; and as this condition is permanent, the colonization of these coasts must forever remain extremely limited.

II. GENERAL HYDROGRAPHY OF THE BASIN.—A single glance at the map (Pl. I.), will disclose the hydrology of this basin. Small lakes abound everywhere, except in the south-west. To the east, in the direction of Davis' Straits, and to the south-east and south, toward the St. Lawrence and its parent lakes, the country is, in fact, essentially lacustrine. From the north-west side of Lake Superior, a chain of small lakes, connected by Winnipeg River, extends north-westwardly to Lake Winnipeg, the largest lake within the basin. Beyond it, in the same direction, the lacustrine zone continues, until the basin is traversed from south-east to north-west. South-west of this chain the number lessens; but to its north-east they abound, quite to the shores of the great bay. All these lakes are either the sources, expansions, or receptacles of rivers, which finally mingle their fresh waters with the briny tides of the bay. Of these rivers, beginning in the east, the principal are, East Main, Rupert, Abbitibbe, and Albany; which, originating in the water-shed that separates the St. Lawrence and the Great Lakes of that basin from the Hudson, discharge themselves into James' Bay. Then follow, in advancing westwardly, the Govern, Hayes', Nelson, and Churchill Rivers, which pour their more copious torrents, including the overflows of Lake Winnipeg, into the southern side of the bay. Further north, is an extensive group of small lakes, having their outlet through a short river, into the head of Chesterfield inlet, a long, narrow arm of the bay, lying nearly in latitude 63°. Of the region in the north, between the bay and the polar seas, but little is accurately known, except that they abound in ice, and are frightfully desolate. From this rapid hydrographical survey, we perceive, that the Hudson Basin, with the exception of its extreme south-west, presents a vast extent of watery surface,

which for more than half the year is bridged over with ice, sometimes ten or twelve feet thick.

III. PHYSICAL GEOGRAPHY OF THE BASIN, NORTH-EAST OF THE CHAIN OF LAKES WHICH INCLUDES LAKE WINNIPEG.—This, which is the larger portion of the basin, includes the bay. Its rocks are chiefly, if not entirely, primitive. The covering of soil is thin and infertile. The annual vegetation is scanty, but advances rapidly during the short summers. The patches of thin forest are composed largely of terobinthinate trees, with oaks, maples, poplars, birches, and willows, generally of stunted size. It probably has no mountains which rise to the altitude of two thousand feet, except they should lie on its eastern margin near the Labrador coast. Its north-west and north includes a part of the "Barren Ground," of which something will be said in the next section. The variety of its resident quadrupeds is not great; the bison is not found within six hundred miles of the bay, and perhaps does not inhabit this portion of the basin; moose and reindeer abound; grallie and graminivorous birds migrate in winter; in summer, the birds of the south, especially the water-fowl, arrive in great numbers, to hatch and rear their young.\*

The northern shores of Hudson's Bay are thinly inhabited by Esquimaux. Scattering hordes of Indians inhabit the regions south and south-east of the bay. The fur companies have establishments at the mouth of Churchill River, Hayes' River, Albany River, Moose River, and Rupert's River, also at the outlet of Lake Winnipeg, and a few other places; but there is no European colony. It need scarcely be stated that autumnal fever does not occur anywhere in this half of the basin we are now exploring.

IV. REGIONS SOUTH AND WEST OF LAKE WINNIPEG.—It is agreeable to turn from a region so desolate, to one which displays a very different character. Its limits, to the north, are the water-shed which divides the Saskatchewan, of Lake Winnipeg, from the Athabasca, of the Arctic basin; to the west, the Rocky Mountains; to the south, the sources of the Missouri, Mississippi, and St. Lawrence. Its area is equal to five or six of the larger states of the Valley of the Mississippi. Its chief rivers are the Saskatchewan, which flows from the slopes of the Rocky Mountains, eastwardly to Lake Winnipeg; Red River, which flows to the north, from the watershed which separates it from the Mississippi; and the Assiniboin, which drains the country between them, and joins Red River, just before the latter pours its waters into the lake. The region we are now in, has everywhere a sub-stratum of secondary rocks, and its surface is smoothed down into plains, which are, in fact, a continuation, to the north, of those traversed by the Missouri River. The trees are chiefly found along the streams; the short grass supports buffalo and other quadrupeds; the streams are frequented by the fur-animals; and the tribes of Indians are more populous than in the other portions of the Hudson Basin. After these general notices, it will be proper to give a minuter account of some portions.



V. VALLEY OF RED RIVER.—The best topographical account of this valley, is that given by Colonel Long,\* who describes the river as originating in part, on the same plateau with the Mississippi, in part on the high plain north of the *Coteau des Prairies*, and, partly, in the intervening depression, where it interlocks with the St. Peter's. Its length is about five hundred miles, but the plain over which it flows is so little inclined to the north, that its current is gentle, and its bed exceedingly tortuous. It has no falls, and its junction with Lake Winnipeg is by a broad, marshy estuary, overspread with aquatic grasses. Throughout its whole course, the banks are low, and unsupported in the rear by hills; its bed is, in fact, a mere trench, dug through the prairies. The margins are overshadowed with forest trees, which increase in size and number as we descend the river.

Colonel Long's party encamped, by night, on the prairies near the river; in reference to which Professor Keating, the historiographer of the expedition, observes:—

"These nights made a more lively impression on several of the party, than any of those that had preceded them. The beautiful and boundless expanse of the prairies, as seen by the bright moonlight which we enjoyed during that period, the freshness of the night air, the stillness of the scenery, interrupted only by the howlings of the wolf and the lowing of the buffalo, the recollections of the dangers from Indians which had lately threatened us, and against the recurrence of which we were then watching; all these were likely to suggest to the mind melancholy yet not unpleasant reflections."

Among the tributaries of Red River, the most important is the Assiniboine, which makes its way from the west. In length and volume, it is equal to the river, with which, about in latitude 50°, its waters mingle. The topographical character of the basin of this tributary, is probably analogous to that of Red River.

*Settlements.*—About the year 1812, Lord Selkirk attempted to plant a European colony, consisting of English, Scotch, and Swiss, on the banks of Red River. Two settlements were effected, of which the upper or southern was near latitude 49°, at the mouth of the small river Pembina, which gave its name to the village; the lower, at the mouth of the Assiniboine, a degree further north. It was called after that river, and constitutes one of the most northern settlements (fur-trading houses excepted) in the Great Interior Valley. In the year 1833, the population of the colony amounted to three thousand and seventy, and may now amount to five thousand.† This, I believe, is the only *Colony* within the Hudson Basin, and the most northern permanent agricultural settlement in the Interior Valley. Colonel Long, who visited this colony, in the month of August, 1823, found the people in health, and says nothing in his journal of autumnal fever. I am, however, informed by him, that not a single case of that disease was seen in the colony; and Doctor Rowand, after residing

\* Second Expedition, Volume II.

† History of the British Colonies, by R. M. Martin, Vol. III, p. 534.

there more recently, has assured me, that both intermittents and remittents are unknown; yet the topographical conditions are favorable to their production. If we may rely on these observations, the latitude of  $49^{\circ}$  N. is beyond the limits of these forms of fever. But doubtless, they cease short of that parallel, though, from the absence of settlements, the latitude cannot be assigned. On the St. Lawrence, we have found them occurring near the forty-seventh degree, but at the level of tide-water; in this basin, at an elevation of seven or eight hundred feet, they may be expected to cease further south. Colonel Long says that his party could hear of none beyond the forty-fifth degree; but I have already mentioned (on doubtful authority) their occurrence at Sandy Lake, in the latitude of  $46^{\circ}$   $48'$ .\*

VI. VALLEY OF THE SASKATCHEWAN. — According to Doctor Richardson,† secondary limestone is the sub-stratum of this great valley, and probably of the whole region from Red River and Lake Winnipeg, to the base of the Rocky Mountains. Argillaceous deposits are common along the lower part of the river; but, further west, the surface becomes sandy or gravelly, and the limestone formations are buried up. The former region presents forest trees on the banks of the river; but the latter is destitute of that embellishment, and produces only short grass. On the north fork of the Saskatchewan there are beds of coal. No colony has yet been planted on the banks of that river; but the fur-trading establishments are numerous. It does not appear that any of them are infested with autumnal fever; but goitre and cretinism are endemic in some localities,—of which more will be said hereafter.

Much of the great region west of Lake Winnipeg and Red river, seems fitted for settlement, but its remoteness, and the motive of keeping it as a hunting and trapping ground, will, perhaps, long prevent its colonization. Its aboriginal and fur-trading populations are more numerous than those of any other portion of this basin, in which respect it is not without interest to the medical historian.

VII. LOCALITY OF THE POLE OF MAGNETIC INTENSITY. — The intensity of terrestrial magnetism is measured by the number and strength of the oscillations of the needle in a given time. Observations have disclosed that, in each hemisphere, there are two poles or *foei* of magnetic intensity, neither of which is coincident with a pole of dip and direction. One is within the basin we are now exploring, in lat.  $62^{\circ}$   $44'$  N. and lon.  $91^{\circ}$   $50'$  W. (See Pl. I). The isodynamic lines, or lines of equal intensity, are "closed and irregular curves" which have their common center at the spot which has been indicated.‡ It is worthy of remark, that Professor Forbes, of Edinburgh, has shown that the magnetic force diminishes as we ascend from the level of the sea.

\* Ante, p. 331.

† Franklin's First Journey to the Polar Sea, p. 452.

‡ Major Sabine: Transactions of the Royal Society for 1846—Proceedings of the British Association. Ibid.

This comprehensive outline of the widely extended HUDSON BASIN, is all that our plan requires. We must now leave it for the fourth and last basin, of which a notice equally concise will be sufficient.

## SECTION II.

### THE ARCTIC HYDROGRAPHICAL BASIN.

I. LIMITS.—This basin includes the remainder of the Interior Valley of North America (*Pl. I*). In the north, it is everywhere terminated by the Polar Sea, which bounds it from the eighty-first to the one hundred and thirty-sixth or thirty-seventh meridian. The range of coast has the mean latitude of  $70^{\circ}$  N. The eastern part of the basin, which lies between Hudson's Bay and the Polar Sea, is comparatively narrow. The longitude of this portion is between  $81^{\circ}$  and  $95^{\circ}$ . After traveling westwardly from the Bay, through ten degrees of longitude, we find the Arctic basin dipping down to the south, and, following the line of separation between it and the Hudson Basin, to the Rocky Mountains, we see it as low as the fifty-fourth parallel; from that point, pursuing its western boundary—the Rocky Mountains—to the Polar Sea, we pass through sixteen degrees of latitude.

II. LAKES.—This basin, like the Hudson basin, is traversed nearly from south-east to north-west by a chain of lakes, which is a continuation of that referred to in the last section (*See Pl. I*). The principal elements of this lacustrine axis, counting from the south, are Lake Athabasca, Great Slave Lake and Great Bear Lake, with numerous appendages and straits. A line drawn through them and prolonged to the south-east, would cut Lake Winnipeg, Lake Superior, Lake Huron, and Lake Erie. The mean latitudes and longitudes of these lakes are nearly as follows:—

Athabasca Lake,	N. lat.	$59^{\circ}$	W. lon.	$109^{\circ}$ .
Great Slave "	"	$61^{\circ} 30'$	"	$113^{\circ} 30'$ .
Great Bear "	"	$66^{\circ}$	"	$120^{\circ}$ .

Between, and to the north-east of, these large lakes, in the direction of Hudson's Bay and the Polar Sea, there is a countless number of small lakes and ponds, some of which are connected with the larger, others insulated. To the south-west they are less numerous.

III. RIVERS.—A chain of small lakes stretches northwardly, from the eastern end of Great Slave Lake, and gives origin to the *Thér-ee-eloh*, *Great Fish*, or *Back's River*; discovered and first descended by the enterprising traveler whose name it bears. This river, the most eastern, as yet known of the Polar Basin, flows by a rapid descent, nearly north-east, to the sea, in Lat.  $67^{\circ} 11'$  N., and Lon.  $94^{\circ} 30'$  W.

*Copper Mine River*, first descended by Hearne, in 1771, and afterward by Franklin, in 1820, has its origin and termination near the northern shore of Great Slave Lake. Beginning, like the last, in a chain of small lakes, it descends to the Arctic Ocean, in Lat.  $67^{\circ} 48'$  N., and Lon.  $115^{\circ} 37'$  W. Its banks are more or less wooded. On the opposite or south-west side of the



Athabasca, Slave, and Bear Lakes, the number of ponds and small lakes, as already stated, is much less; but the rivers are of greater length and volume, being supplied by the Rocky Mountains. Although receiving different names, they finally unite into one trunk, first descended by Mackenzie, in 1789, and subsequently by Franklin, in 1823. It has received the name of its first navigator, and deserves a more extended notice than the preceding.

*Mackenzie's River* is of Rocky Mountain origin. Under the name of Athabasca, it commences in those mountains, about in latitude  $52^{\circ}$  and longitude  $116^{\circ}$ , and flowing to the north-east, pours its waters into the lake which bears its name. A few degrees further north and west, the same mountains send down another, the *Unjigah*, or *Peace River*; which, flowing nearly in the same direction, passes close to the western extremity of Athabasca Lake, with which it is connected by straits or bayous, through which, when swollen, a part of its waters enter that lake, to be returned when it subsides. Having established this connection, it turns to the north, and taking the name of Slave River, pours its accumulated waters into the south side of the Great Slave Lake. Still further north than the sources of the Athabasca, the Rocky Mountains throw down another river, the *Turnagain*, or *Liards*, which first flows to the east, and then to the north, to join the outlet of Great Slave Lake, and form the Mackenzie, which, pressing hard upon the base of the Rocky Mountains, seeks the ocean by a north-west course. On its way, the volume of its water is augmented by the affluent or outlet of Great Bear Lake. Its junction with the Arctic Sea, marked by a broad estuary, abounding in islands, is in mean Lat.  $69^{\circ}$  N., and Lon.  $136^{\circ}$  W. Thus it drains the north-west corner of the Great Interior Valley, and takes the same rank among the rivers of the Arctic Basin, with Nelson's River in the Hudson, the St. Lawrence in the basin of that name, and the Mississippi, in the Mexican basin.

IV. PHYSICAL GEOGRAPHY OF THE REGION WEST OF THE LACUSTRINE AXIS.—The region lying between Athabasca, Slave, and Bear Lakes, on the one hand, and the Rocky Mountains on the other, traversed, as we have just seen, by the rivers which compose the main trunk of the Mackenzie, is, properly, a continuation of the great inclined plain, which descends eastwardly from the base of the Rocky Mountains, and has been already described as making a part of the Hudson and Mexican Basins; but in these high latitudes it becomes much narrower. Extending, with some modifications, from the mouth of the Rio Grande, of the Gulf of Mexico, to the *embouchure* of the Mackenzie, in the Arctic Sea, it ranges through forty-four degrees of latitude, and is doubtless the longest tract of the kind, which the earth anywhere presents. From south to north, it has certain characters in common: *First*, It is most elevated near the Rocky Mountains, which everywhere bound it to the west. *Second*, The secondary formations which constitute its surface, are more or less buried up with the *debris* of the rocks and that of the mountains. *Third*, It is deficient in springs, because the rains which fall upon it are imbibed by this *debris*, and not afterward collected into subterranean streams. *Fourth*, Its scanty forests are chiefly

found on the humid banks of the rivers. *Fifth*, The intervening plains (prairies) are covered with grass. *Sixth*, It is the great pasturo-field of the bison, which, except in the valley of the Ohio, has not been found in numbers, east of its limits; but ranges north upon it, up to the fifty-second degree of latitude.\* *Seventh*, It is inhabited throughout by Indians, who wander over it, like the wild herds on which they subsist. *Eighth*, Like that part of the Hudson Basin which lies to the south, it is a fur-country, and the Hudson's Bay, and North West Companies, have factories in various parts of both.

If autumnal fever does not exist in the prairies of the Hudson Basin, at the latitude of  $49^{\circ}$  N., we should not expect to read of its occurrence in the same latitude in the region west of the lacustrine axis, and we have no accounts of its existence there.

V. PHYSICAL GEOGRAPHY OF THE REGION EAST OF THE LACUSTRINE AXIS. — The topography of this portion of the Arctic Basin, presents a striking contrast with that just described. While the latter enjoys a substratum of secondary rocks — argillaceous, calcareous, and carboniferous — the disintegration of which, with the *debris* of the mountains, brought down by many large rivers, gives a soil capable of supporting a tree and herbaceous vegetation, up to the latitude of  $68^{\circ}$  or  $69^{\circ}$ , thus rendering it habitable; the former is composed almost entirely of primitive rocks, of which gneiss is the principal, with extreme deficiency of soil, and excess of water, because the strata below are impervious, while the prevailing flatness of surface leads to its accumulation into swamps, pools, and small lakes, which the severity of its winters converts largely into ice, that is not entirely melted in summer. For a certain distance, east and north-east of Great Slave and Athabasca Lakes, the sterility is less, and open forests of dwarf pine, poplar, birch, and willow, are not entirely wanting; but beyond a line, drawn from the middle of Great Bear Lake, in latitude  $65^{\circ}$ , to Hudson's Bay, in latitude  $60^{\circ}$ , the Arctic, like the adjacent portion of the Hudson Basin, is utterly uninhabitable by civilized races. The region to the north-east of that line constitutes, in fact, the "*Barren Ground*" of the Indians and the British traders and travelers. Of the last, it has been traversed by Hearne, Franklin, Richardson, and Back; while Ross was imprisoned for three years on its icy coast, in the Gulf of Boothia, not far from the mouth of Thlew-ee-choh, or Back's River. All the accounts of these hardy and courageous travelers, concur in representing this great region, with the exception of the banks of Copper Mine River, which are the best, as one of the most repulsive and uninhabitable on the globe; and yet it is more or less traveled over by Indians in summer; and its northern borders are the permanent residence of tribes of Esquimaux, whose subsistence, however, is drawn chiefly from the sea, through apertures made in the ice.

VI. THE ARCTIC OCEAN. — No portion of the universal ocean is less known, than that which throws its eternal ices on the northern coasts of the

\* Richardson.

Interior Valley of our continent. For more than two hundred and seventy years, all the attempts to cross it, to the west, from Baffin's Bay, have ended in disappointments, equalled only by the intense sufferings of those who have regarded the glory of discovering a "North-west Passage" from the Atlantic to the Pacific Ocean, as paramount to all exposures, hardships, and perils. Not even a coasting voyage, in the latitude of seventy degrees, from the peninsula called Boothia Felix, to Bohring's Straits, has yet been performed. In a latitude four degrees further north, Melville Island, in longitude  $110^{\circ}$ , is the furthest land which has been explored in the western voyage. Whether the Arctic Sea extends to the north pole is quite unknown; but since the continents of both the old and the new world terminate near the same latitude, the presumption is in favor of the existence of a true polar sea. The route from Baffin's Bay to Melville Island, is through Lancaster Sound and Barrow's Straits. On the south lies Cockburn Island, unexplored — on the north the land is probably insular. From the straits, Prince Regent's Inlet dips down to the south, with the island just named on its east, and the peninsula of Boothia Felix on its west. The termination of this inlet is in an expansion called the Gulf of Boothia. These lands are buried up in snow and ice through most of the year, and are destitute of trees. Much of them rises but a few hundred feet above the level of the sea, and not a single elevation deserving the name of mountain has been met with. To the west of them lies an impenetrable icy ocean.

VII. LOCALITY OF THE POLE OF COLD. — Thermometrical observations in the polar regions, have enabled the mathematical meteorologist to determine, that there is not *one* pole of cold for the northern hemisphere, and that, coincident with the terrestrial pole, as might have been expected — but *two*, of which one is in the continent of Asia, the other of America, nearly  $180$  degrees apart. These regions of lowest terrestrial temperature, are nearly in the same latitude. That of America ( *V. V.* ) covers the sound, strait, inlet, peninsula, and island mentioned under the preceding head, which lie in the mean longitude of  $90^{\circ}$  W., and the mean latitude of  $75^{\circ}$  N.\* Thus, the Valley of the Mississippi, the Upper Lakes, and Hudson's Bay, are directly south of the pole of cold for this continent.

We have seen in the preceding section, that the pole of magnetic intensity is found between Lake Superior and Hudson's Bay, in the ninety-second meridian, and consequently it coincides, in longitude, with the pole of cold.

VIII. LOCALITY OF THE MAGNETIC POLE OF DIRECTION AND DIP. — Modern researches in terrestrial magnetism have demonstrated that, instead of two poles of magnetic dip and direction, corresponding to the poles of the earth, there are two in each hemisphere, all of which are found at some distance from the terrestrial poles. In the northern hemisphere, one exists on the continent of Asia, the other on that of America. By calculation from numerous data, their places were assigned, *a priori*, with such precision, that an observer was enabled to reach that of this continent, and, by experi-

\* Knemtz's Course of Meteorology, London Ed., by C. V. Walker.



ment, confirm the results of mathematical deduction. In the summer of one of the tedious years, during which the British ship *Victory*, commanded by Captain, now Sir John Ross, R. N., was lying, ice-bound, in Victory Harbor, on the western side of the Gulf of Boothia, Commander, since Captain James C. Ross, aware of their proximity to the spot which had excited so much curiosity in the scientific world, made a journey of thirty miles, along the south-western coast of the peninsula called Boothia Felix, and, on the first of June, 1831, found himself on the MAGNETIC POLE. The needle no longer had any horizontal motion, and its dip was  $89^{\circ} 59' 86''$ , within less than a quarter of a minute of being vertical. The latitude of the place where this observation was made, proved to be  $70^{\circ} 5' 17''$  N., its longitude  $96^{\circ} 45' 48''$  W. A cairn of sea-side pebbles was erected, and the British flag left waving over it.\*

It will be observed that the magnetic pole of dip and direction is  $17^{\circ} 46'$  N., and  $1^{\circ} 46'$  W. of the pole of magnetic intensity; and that it falls within the (imperfectly defined) limits of the pole of cold. In reference to more southern parts of the Interior Valley of the continent, the astronomical meridian of  $96^{\circ} 45' 48''$ , passes nearly over the center of the great plains between the Mississippi River and the Rocky Mountains.

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#### TOPOGRAPHY CONCLUDED.

With these notices of the Arctic Basin, our geographical, topographical, and hydrographical survey of the Interior Valley of North America is brought to a close; except when the study of particular forms of disease may recall us to the work of description. Of the four hydrographical basins, the two southern are not equal in area to the two northern; yet they must forever contain nearly all the civilized inhabitants of the Valley. From the Gulf of Mexico to the Polar Sea, the distance is equal to forty degrees of latitude; and if this be divided by the fiftieth parallel, that portion of the valley which lies beyond it, will remain nearly destitute of inhabitants, while much the larger part of the other will admit of settlement, though in very unequal degrees. The inhospitable character of the northern basins does not result, however, from the nature of their surface alone, but from that and their climate combined, of which we shall see conclusive proofs in the investigations on which we are now prepared to enter. If the different basins were separated from each other by parallels of latitude, the climate of each might, like its topography, be studied by itself; but many portions of the two eastern lie in the same latitudes with the two western, and consequently possess the same climates; it will be necessary, therefore, to study the meteorology of the whole in connection, beginning in the south and proceeding to the north.

\* Ross's Second Voyage, Am. Ed. p. 331, Trans. Roy. Soc., 1836, Part 1, p. 52.









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